National Aeronautics and
Space Administration

John H. Glenn Research Center
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Plum Brook Station
Sandusky, OH 44870

March 25, 2010

Reply to Attn of: QD

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D.C. 20555

Subject: Final Status Survey Report, Attachment 1, Reactor Office and Laboratory Building, for the Plum Brook Reactor Facility, Licenses Nos. TR-3, Docket No. 50-30 and R-93, Docket No, 50-185

Enclosed for your review is the first in a series of reports on the Final Status Surveys supporting eventual termination of the licenses for the Plum Brook Reactor Facility.

As previously discussed with members of the NRC Staff, the complete Final Status Survey Report will consist of series of Attachments. Each attachment addresses an individual survey area or group of survey areas or environmental areas as described in our NRC approved Final Status Survey Plan. The final submission will be the main body of the Final Status Survey Report. It will consolidate and summarize the details presented in the Attachments. We committed to the staff to submit the Attachments as they were generated to allow easier staff review of the reports over a period of time.

This first in the series of Attachments addresses the Final Status Survey of the Reactor Office and Laboratory Building (Building 1141). It supports our conclusion that radiological remediation of the building has been completed and the structure meets the criteria for unrestricted release specified in 10 CFR 20.1402.

Should you have any questions or need additional information, please contact me a NASA Plum Brook Station, 6100 Columbus Avenue, Sandusky, Ohio 44870, or by telephone at (419) 621-3277.

Sincerely,

Keith M. Peecook
NASA Decommissioning Program Manager

NMSSO(
FSME

Enclosure

1. Plum Brook Reactor Facility Final Status Survey Report, Attachment 1, Reactor Office and Laboratory Building, revision 0, dated March 25, 2010

cc:
USNRC/C. J. Glenn (FSME)
USNRC/J. Webb (FSME)
USNRC/W. G. Snell RIII/DNMS/DB
ODH/M. J. Rubadue

Plum Brook Reactor Facility

Final Status Survey Report

Attachment 1

Revision 0

Reactor Office and Laboratory Building (Building 1141)

FINAL STATUS SURVEY REPORT
ROUTING AND APPROVAL SHEET

Document Title: Final Status Survey Report,
Attachment 1
Reactor Office and Laboratory Building (Building 1141)

Revision Number: 0

ROUTING

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Prepared By	N/A	
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LIST OF ACRONYMS & SYMBOLS

α	alpha; denotes alpha radiation, also type I error probability in hypothesis testing
A	Area, also detector open area
A_{EMC}	Area corresponding to the area factor calculated using the scan MDC
AEC	Atomic Energy Commission
ALARA	As Low As Reasonable Achievable
AF	Area Factor
β	beta; denotes beta radiation, also type II error probability in hypothesis testing
b_i	background counts in observation interval
B_R	Background count rate
BPL	Byproduct License
CFR	Code of Federal Regulations
cm	centimeters
cm^2	square Centimeters
cpm	counts per Minute
Δ	delta, $DCGL_W$ – LGBR
d'	Scan surveyor sensitivity index
DCGL	Derived Concentration Guideline Level
$DCGL_{EMC}$	DCGL for small areas of elevated activity, used with the Elevated Measurement Comparison test (EMC)
$DCGL_W$	DCGL for average concentrations over a survey unit, used with statistical tests. (the "W" suffix denotes "Wilcoxon)"
dpm	disintegrations per minute
E_i	Detector, or instrument efficiency
E_s	Surface efficiency
E_t	Total efficiency
EMC	Elevated Measurement Comparison
EPA	US Environmental Protection Agency
FH	Fan House, Building 1132
FSS	Final Status Survey
FSSP	Final Status Survey Plan
FSSR	Final Status Survey Report
γ	gamma
g	gram
HTD	Hard To Detect
HL	Hot Laboratory, Building 1112
HRA	Hot Retention Area
i	observation counting interval during scan surveys
in.	inch
HVAC	Heating, ventilation and air conditioning
LMI	Ludlum Measurements, Inc.
LBGR	Lower Bound of the Gray Region
m^2	square meters
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual

LIST OF ACRONYMS & SYMBOLS, Continued

MDC	Minimum Detectable Concentration
MDC_{scan}	Minimum Detectable Concentration for scanning surveys
MDC_{static}	Minimum Detectable Concentration for static surface activity measurements
MDCR	Minimum Detectable Count Rate
mrem	millirem
MW	Megawatt
MWH	Montgomery Watson Harza, Inc.
NASA	National Aeronautics and Space Administration
N	Number of FSS measurements or samples established in a survey design
NA	Not Applicable
NaI	Sodium Iodide
NRC	US Nuclear Regulatory Commission
OW&R	Outside Walls and Roof
PBRF	Plum Brook Reactor Facility
PNL	Pacific Northwest Laboratory
Φ	Standard normal distribution function
p	surveyor efficiency for scan surveys
pCi/g	picocuries per gram
%	percent
QC	Quality Control
RESRAD	RESidual RADioactive – a pathway analysis computer code developed by Argonne National Laboratory for assessment of radiation doses. It is used to derive cleanup guideline values for soils contaminated with radioactive materials
RESRAD-BUILD	A companion code to RESRAD for evaluating indoor building contamination and developing site-specific DCGLs
ROB	Reactor Office Building, Building 1142
ROLB	Reactor Office and Laboratory Building, Building 1141
s	seconds
σ	generic symbol for standard deviation of a population
S^+	Sign Test statistic
SEB	Reactor Service Equipment Building, Building 1131
SNM	Special Nuclear Materials
SNL	Sandia National Laboratory
SR	Survey Request
STMA	Surface Measurement Test Area
t_s	background count time
t_b	sample count time
TBD	Technical Basis Document
μ	Mean activity concentration
UCM	Unusual Condition Measurement
UL	Upper limit of the confidence interval about the mean
VSP	Visual Sample Plan
$Z_{1-\alpha}$	Proportion of standard normal distribution values less than $1-\alpha$
$Z_{1-\beta}$	Proportion of standard normal distribution values less than $1-\beta$
∞	Mathematical symbol for infinity

1.0 Introduction

This report presents the results of the final status radiological survey of the Plum Brook Reactor Facility (PBRF) Reactor Office and Laboratory Building (ROLB, Building 1141). It is Attachment 1 of the PBRF Final Status Survey Report (FSSR) [1]. This attachment describes the ROLB, its operational history and final condition for the final status survey (FSS). It describes the methods used in the FSS and presents the results of the survey measurements.

As stated in the PBRF Final Status Survey Plan (FSSP) [NASA 2007], the goal of the decommissioning project is to release the facility for unrestricted use in compliance with the criteria in US NRC 10CFR20 Subpart E. The principal criterion is that the dose to future site occupants will be less than 25 mrem/y. Subpart E also requires that residual contamination be reduced to levels as low as reasonably achievable (ALARA). A Derived Concentration Guideline Level (DCGL) for residual surface contamination has been established for the ROLB. Considering the radionuclide mixture established for the ROLB, the gross beta DCGL is 27,166 dpm/100-cm^2. The DCGLs for soil beneath the ROLB are: Co-60, 3.8 pCi/g; Sr-90, 5.4 pCi/g and Cs-137, 14.7 pCi/g.

The survey measurement results and supporting information presented herein demonstrate that residual contamination levels in each survey unit of the ROLB are well below the DCGL. Additionally, it is shown that residual contamination has been reduced to levels that are consistent with the ALARA requirement. Therefore, the ROLB meets the criteria for unrestricted release.

Section 2.0 of the report provides a description of the ROLB. This includes the building layout, its relation to other PBRF buildings and facilities, design and materials of construction, building contents and use, systems and services, building modifications, final configuration of the ROLB for the FSS and scope of the FSS for this building.

A brief history of operations is presented in Section 3.0. A chronology of significant milestones is followed by history of operations with radioactive materials. Post shutdown and decommissioning activities are summarized.

Section 4.0 presents the FSS design for the ROLB. This section includes FSS Plan requirements applicable to the ROLB, breakdown into survey units and assignment of MARSSIM classification to each, the survey design approach, and instrumentation used for the FSS and measurement sensitivities.

Survey results are presented in Section 5.0. This section includes a summary of the FSS measurements performed in the ROLB survey units, comparison to the DCGL, tests performed and an evaluation of residual contamination levels relative to the ALARA criterion.

Supporting information is contained in Appendices. Appendix A contains photos and schematics to supplement the text. Survey design maps and tables of coordinates for the measurement locations in each survey unit are provided in Appendix B.

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[1] The PBRF Final Status Survey Report comprises the report main body and several attachments. The attachments present survey results for individual buildings and open land areas. The entire final report will provide the basis for requesting termination of NRC Licenses TR-3 and R-93 in accordance with 10CFR50.82 (b) (6).

2.0 ROLB Description

The ROLB is a three story, 27,000 ft^2 (floor area) structure located immediately west of the Reactor Building. The ROLB, identified as Building 1141, is shown on the PBRF site map in Figure 1. Exhibit 1, Appendix A, shows the building, viewed from the west with the Reactor Building at the rear in 2009. The ROLB contained offices, a conference room, a classroom, a library, repair shops, health physics offices, a first aid facility, instrument calibration shop, new fuel vault, equipment calibration facility, and radiochemistry laboratories. The east wall of the ROLB abuts the west wall of the Reactor Building. The east end of the ROLB extends 53 ft. south from the northwest corner of the Reactor Building along the west wall. The buildings are structurally independent. Exhibits 2-4, of Appendix A, show the 1st floor, 2nd floor and basement layouts.

The ROLB was initially occupied in early 1959, prior to Plum Brook Test Reactor criticality in June 1961. It was occupied through the entire period of reactor operations and during the post-shutdown period until July 1, 1973.

Most PBRF management and technical staff occupied offices in the ROLB until completion of the Reactor Office Building (ROB, Building 1142) in 1965. During the period from 1959 to 1965, the ROLB housed about 75 NASA managers, technical staff (scientists and engineers) administrative staff and technical support staff. Technical support staff included electronics technicians, mechanics, machinists and contractor Health Physics personnel. The number of personnel occupying the ROLB was reduced somewhat when ROB office space became available. The ROLB occupancy remained at approximately 60 until 1968 when NASA budget cuts resulted in minor reduction of reactor staff housed in the building. Beginning in January 1973, with termination of reactor operations, ROLB occupancy ramped down until the end of June 1973 when the building was vacated.

The elevation of the ROLB first floor is at grade level, corresponding to Reactor Building 0 ft. elevation (625 ft. above mean sea level). Other major elevations are: basement, -15 ft.; second floor, 12 ft. and roof, 24 ft. 3 in. The ROLB connects to the Reactor Building through doorways at the basement, first and second floor levels. The Reactor Building roof is accessible from the ROLB roof.

2.1 Building Construction

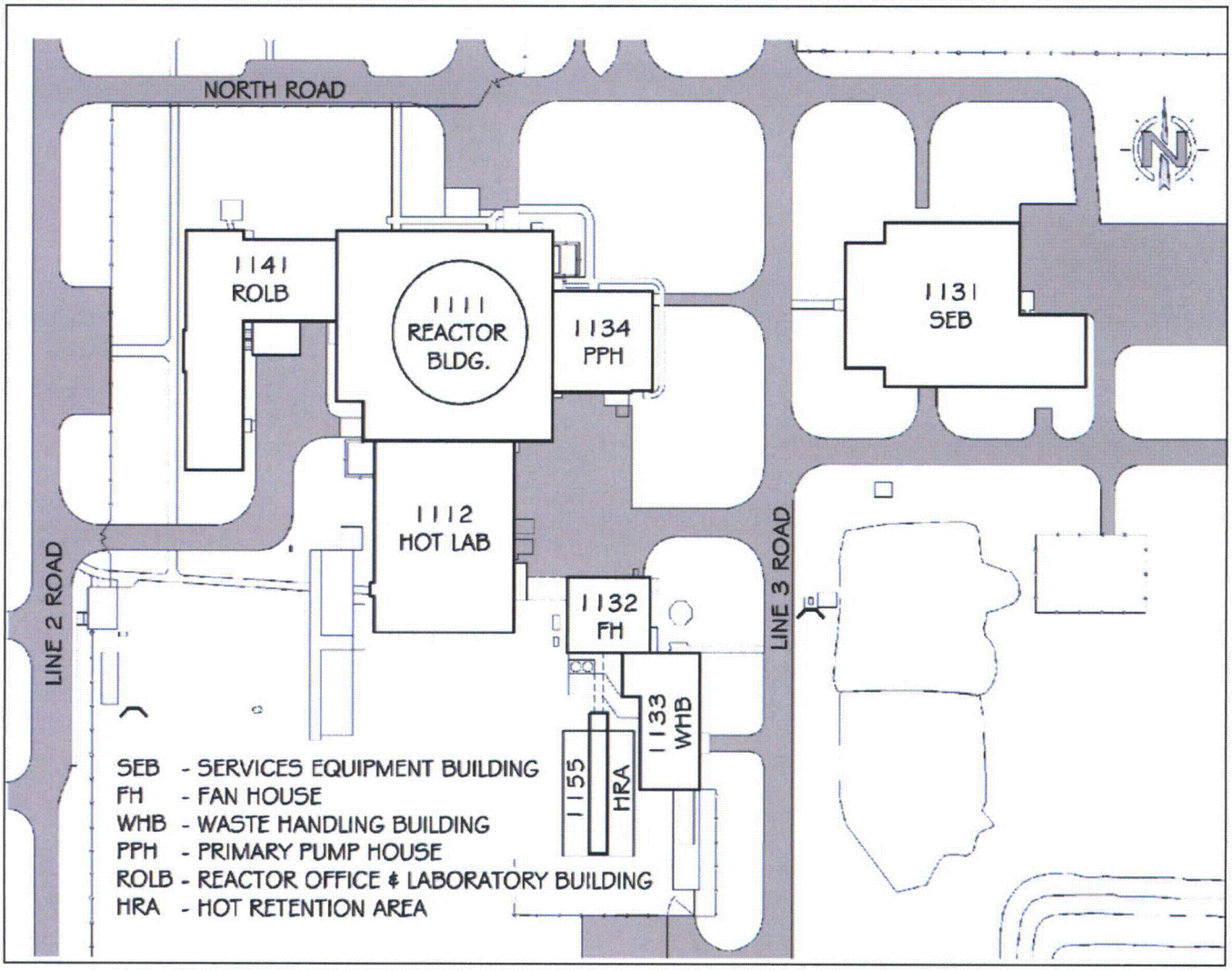
The building is constructed of poured concrete floors supported by concrete and steel columns and beams. Basement walls are poured concrete. First and second floor exterior walls are concrete block with brick veneer. The roof is of composite construction - a concrete slab covered with light concrete fill, rigid insulation and a tar-stone mixture. The roof was modified in the mid 1980's (and possibly a second time in the 1990's) with the addition of foam sealant to eliminate in-leakage to the building [PBRF 2009].[2]

A variety of surface and finish materials were used in ROLB construction and many remain at present. Door and window frames are steel, windows are of steel-framed glass construction. Interior doors are mostly wood, except for a metal door on the new fuel vault. The three

[2] The foam sealant was removed in 2009 to provide access to the original roof surface for the Final Status Survey.

double doors connecting the ROLB and Reactor Buildings and several exterior entrance doors are of metal construction. The first and second floors were covered with asbestos tile. Interior wall coverings included painted concrete, metal lath and plaster, drywall and paneling.

Figure 1, PBRF NW Area Showing Reactor Building, ROLB and Support Buildings



2.2 Building Systems and Services

The ROLB systems included standard laboratory building services as well as radioactive air and liquid waste handling systems. Systems in the ROLB are briefly described to provide background information and to identify contaminated systems and the building areas potentially impacted by them. It is noted that most of the process systems and utility services at the PBRF serviced multiple buildings, including the ROLB.

The ROLB first and second floor rooms were cooled by individual room heating/air conditioning units. Basement cooling was handled by a 4500 cfm, multi-zone unit with fresh air makeup. Cooling air exhaust from the basement was tied in to the 16-inch experimental waste air main in the Reactor Building -15 ft. elevation. The 16-inch waste air line exhausted through the PBRF stack via the Fan House. The second floor laboratory area was supplied with forced air at 6000 cfm from the second floor office area HVAC surplus. There were four roof ventilators, one from the basement, one from the washrooms, one from the first and second floor office area and one from a filter unit which exhausted surplus air from the laboratory work area. Exhaust air from laboratory hoods in the ROLB was routed through individual HEPA filter units to exhaust fans located on the roof where the air was discharged to the atmosphere.

High-pressure steam for room heating and domestic hot water was supplied to the ROLB by two boilers located in the Service and Equipment Building (SEB). Domestic water was supplied to the ROLB and the other PBRF buildings from the Sandusky water treatment plant. Fire protection system water was supplied to the ROLB as part of an 8 in. piping loop which delivered raw Lake Erie water from Plum Brook Station Storage Reservoir No. 1 to the Reactor Building, Hot Laboratory (HL) Building and the ROLB. The HL, Building 1112, is adjacent to the Reactor Building south side as shown in Figure 1.

De-ionized water to the PBRF buildings, including the ROLB was supplied from mixed bed deionizers located in the SEB. Water from the PBRF Process Water System was also supplied to the ROLB via a 2 inch line that entered the basement from the Reactor Building -15 ft. elevation. If deionized water was unavailable, water from the Process Water System was used for equipment cleaning, and dilution water. Secondary cooling water was used for equipment cooling by heat transfer and dissipation through the PBRF cooling tower.

Service and instrument air was supplied to laboratories and test areas in the ROLB from the utility air system in the SEB. Natural gas was supplied to the PBRF buildings including the ROLB by the Columbia Gas Company. A 2 in. line tied in to an 8 in. main supply line at the SEB entered the ROLB basement. Gas was supplied to individual laboratories by one-inch lines.

Bottled gas was supplied to ROLB laboratories from supply tank cylinders connected to a manifold located in the ROLB basement. Seventeen ½ inch diameter lines from the manifold supplied the individual laboratories. Commonly available gases included helium, argon, CO_2 and nitrogen.

The ROLB contained collection sumps for radioactive and non-radioactive process waste water and sanitary waste. These are summarized in Table 1.

Table 1, ROLB Sumps

System	Description
Hot Drain Sump	The hot sump collected radioactively "hot" drainage from the radiochemistry laboratories (primarily sinks and laboratory eye washes) and other locations where wastewater drainage originated directly or indirectly from radioactively contaminated areas. Sump output was routed to the Hot Retention Area through the Hot Laboratory Hot Pipe Tunnel for storage decay, cleanup or controlled release.
Hot-Cold Sump	The hot-cold sump collected potentially contaminated water from the above sources plus second floor area floor drains, including the rest rooms and locker room.
Cold Sump	The cold sump collected wastewater from all uses that were not likely to be contaminated. This included the 1st floor rest room floor drains.
Sewage Sump	The sewage sump collected all wastewater from the lavatory areas (toilets, showers, sinks, etc.), except the floor drains.

2.3 Building Modifications

As described in Section 2.1, the ROLB was constructed as a multipurpose office and laboratory building. As such, modifications occurred throughout the 1960-1973 period. Some equipment was installed during original construction and other equipment was added in response to new or revised mission requirements. For example, a radiation detector/instrumentation calibration facility was added outside the northwest corner of the basement in the 1961 timeframe. Access to the calibration facility was provided through a passage from the radiation instrument repair room. Modifications to the ROLB were made to add analytical equipment to the second floor radiochemistry laboratories. Emergency showers and eye wash stations were installed (in 1963-64).

Other modifications were made to improve safety and efficiency of laboratory operations. These included adding filter housings, cabinets, fume hoods and shielded glove boxes. Research equipment was upgraded and new replacements installed (mass spectrometer, spectro-photometer, infrared analyzer, etc.) in the late 1960s. Some office areas were modified; primarily wall partition rearrangements during the operations phase to facilitate organizational changes. Room rearrangements in the electronics shops, health physics and radiochemistry laboratories areas were also made in this period.

2.4 Final Configuration and Scope

Configuration of the ROLB for the FSS and the period until license termination is controlled by PBRF decommissioning and FSS procedures. The structure remains intact with utilities and services limited to temporary lighting. All furniture, furnishings and equipment have been removed. Most floor coverings, wall coverings and false ceilings have been removed. Electrical conduit, drains, HVAC ducts, hood ventilation ducts and plumbing fixtures have been removed. All piping was drained and removed and all sumps deactivated, except for the north sump which is maintained to control groundwater intrusion. Exhibits 5 through 15 of Appendix A, show the condition and configuration of representative rooms and areas in the ROLB at the time of the final status survey.

The scope of FSS measurement results reported in this attachment includes building interior and exterior surfaces and the surface soil beneath the basement crawl space. It includes surface attachments, temporary safety covers and small embedded fixtures, for example pipe and conduit stubs such as shown in Exhibit 15 of Attachment A. It does not include FSS measurement results for piping embedded in ROLB concrete or buried beneath or adjacent to the building. The results for these commodities are reported in separate attachments to the FSS Report.

3.0 ROLB History and Operations with Radioactive Materials

A chronology of ROLB milestones is given below. This is followed by a discussion of building operations, post-shutdown and decommissioning activities. Emphasis is on operations with radioactive materials that could affect the final building condition and final status survey.[3]

3.1 Chronology

1956 – September, groundbreaking for PBRF

1957 – ROLB construction initiated [4]

1959 – Jan-Feb. Initial ROLB occupancy

1961 – June, 60 Mw Test Reactor critical

[3] Information sources for the history and pre-decommissioning period include, construction photos, construction drawings, PBRF operating cycle reports, Radiochemistry periodic reports, PBRF Annual Reports, Unusual Occurrence Files, memoranda and other historical files maintained by PBRF Document Control.

[4] Construction photos show that the ROLB was under construction in 1958. It is believed that construction began about one year after Reactor groundbreaking. One photo shows that the building was nearly complete except for window installation in November 1958 [PBRF 2009].

1973- January 5th, Reactor shutdown

1973 – June 30, ROLB vacated and placed in "standby condition". New Reactor Fuel and radioactive sources removed.

1984 – Major roof repair to prevent water in-leakage

1985 – Initial radiological characterization, Teledyne Isotopes Inc.

1989 – Follow-up radiological characterization, GTS-Duratek

2002 – Decommissioning Plan approved. Equipment and cabinets removed; initial building decontamination.

2003- 2005 – Temporary storage of contaminated equipment in ROLB during D&D of the PBRF.

2006- 2007 - Remediation of contaminated areas and preparation for FSS.

2008 – FSS measurements completed in ROLB interior.

2009 – Roof covering removed.

2009 - FSS measurements of ROLB roof and exterior walls completed.

3.2 Operations with Radioactive Materials

The US Atomic Energy Commission (AEC) authorized operations and use of radioactive materials at the PBRF under several licenses.[5] License No.TR-3 (Docket 50-30) authorized the 60 MW test reactor. The 100 KW mock-up reactor was licensed under License No.R-93. A broad byproduct license (BPL) No. 34-06706-03, authorized possession and use of radioactive materials (byproduct material) produced by the Plum Brook 60MW and Mockup reactors and other radioactive materials. This license also covered Hot Laboratory operations and related analytical activities in the radiochemistry laboratories. Special Nuclear Materials license SNM 605 covered the right to possess and irradiate limited quantities of source and special nuclear materials.

A wide variety of radioactive liquids, gases and solids were stored, handled in the ROLB and analyzed in the ROLB laboratories during the operations period. Typically, radioactive materials were transported from the Reactor Building, Containment Vessel, Hot Laboratory, Primary Pump House and other PBRF locations to the radiochemistry and metallurgy laboratories in the ROLB. Items such as primary reactor coolant samples, flux wires from the Plum Brook test reactor and the Mock-up reactor, PBRF reactor vessel material specimens,

[5] Authority for the PBRF reactor and radioactive materials licenses was assumed by the US Nuclear Regulatory Commission in 1975.

small experiment specimens (such as irradiated space- related experiment samples, moon rocks, corn, coal, petroleum samples, etc.) were routinely carried in lead casks or other shielded containers for counting and analysis in the ROLB labs.

Controls for radioactive materials included inventory records of radioactive materials at the PBRF, including the ROLB. These recorded receipts, storage, transfer and disposition of individual sources. Radionuclides recorded on inventory sheets included tritium, C-14, Na-22, P-32, Sc-46, Cr-51, Mn-54, Fe-55, Fe-59, Co-60, Ni-63, Zn-65, Kr-85, Sr-90, Ru-106, Cd-109, Ag-110m, Cd-115, Ba-133, Ce-144, Cs-137, Nd-147, Pm-147, Eu-152, Eu-154, Ta-182, W-185, Hg-203, Tl-204, Po-210, mixed fission products, Radium, Uranium (natural, depleted and enriched), Am-Be neutron sources and Np-237. Most of the source inventory was disposed as radioactive waste during operations (1961-73) and during the transition to "mothball" status in 1973. The remainder was transferred to other licensees, returned to the AEC, or stored on-site for potential future use.

During operations, activities within PBRF facilities involving radioactive materials were well documented in PBRF cycle reports, radiochemistry periodic and special reports, PBRF annual reports, and experiment results reports. These included activities involving the radiochemistry and metallurgical laboratories, counting rooms, etc. pertinent to the Test Reactor, the Mock-up Reactor, associated experimental programs and Hot Laboratory operations.

The PBRF Procedure, ADM-1402-6, Inventory and Control of Radioactive Materials, outlined the process for controlling radioactive materials, including sealed sources and other radioactive materials (on-site reactor generated), except nuclear fuel for the two PBRF reactors. On several occasions, incidents involving loss of control of radioactive materials in the ROLB were reported. These were recorded in Operations Cycle reports. Most of the reported events occurred in or near the 2nd Floor radiochemistry laboratories. They included spills and airborne release of un-encapsulated radioactive material. Radionuclides involved in these reported events included tritium gas, Co-60, W-185 and Np-237.

3.3 Disposition of Materials in the Post-Shutdown Period

Notification was received on January 5, 1973 that NASA was terminating all nuclear related operations at PBRF due to budget constraints.[6] The test reactor, mock-up reactor, hot laboratory and all associated operations were to be placed in standby condition by June 30, 1973. This included termination of the reactor facility operations staff.

Following notification, the test reactor (60 MW) was immediately shutdown on January 5th. A Master Plan was developed to address the activities associated with terminating the operating licenses for PBRF and placing the facility in a standby status. End condition statements were developed. These specified the final conditions for all buildings, structures and equipment on the PBRF site as of June 30, 1973. Both the initial Master Plan and the End Condition Statements were subject to revision as activities progressed or conditions changed.

[6] This section is adapted from the December 2009 memorandum to file prepared by J. L. Crooks and Don Young, PBRF retirees [PBRF 2009].

The ROLB status was included in the plans and statements described above. These indicated that the majority of the equipment in the offices and some of the equipment and other items in the ROLB laboratories were removed. Equipment remaining in the laboratories included fume hoods, sinks, drains (hot and cold), etc. The roof openings for all laboratory hood vents were covered and sealed per Shutdown Procedure OSY-3301-S04. Services to the building were terminated with the exception of electricity and the operation of three sumps in the basement. Sanitary systems and water were cut off, the heating system was secured, and laboratory hoods were tagged and the access doors cabled shut to prevent entry.

All source (i.e., natural uranium) and special nuclear material were to be removed from the facility (including the ROLB); except for calibration sources covered by general licenses per 10CFR70 and 10CFR40. Materials removed included fuel elements (new and spent, MTR-type 93 per cent enriched uranium aluminum alloy), fission chambers, plutonium-beryllium neutron sources for MUR startup and neutron calibration. Also removed were sealed and unsealed byproduct sources (such as a polonium-beryllium neutron source), Ce-144, Au-198, Cs-137, Co-60 and others. The items for removal were identified and either disposed of as radioactive waste, transferred to other licensed facilities, returned to the AEC for credit or stored for calibration of radiation monitoring equipment. The latter were to be used for site and environmental monitoring during the protected safe storage mode. Some sources were also temporarily stored in safes in the ROLB for possible use while future test reactor or mock-up reactor restart was considered. Any known sources of contamination such as hot drain lines were tagged and labeled.

Following the final reactor shutdown in January 1973, the remaining new fuel was transferred to Oak Ridge National Laboratory (118 standard and 26 control rod fuel elements). A final inventory for the ROLB vault, dated May 1973, is available in the Shutdown Team records. The disposition records for all sources and special nuclear materials located within the ROLB can be found, or referred, to in the Shutdown Team records and AEC Material Transfer Form 740 series records.

Beginning in mid-1973, activities at PBRF were controlled according to modified AEC/NRC possession only licenses TR-3, R-93 and BPL No. 34-060706-03. The by-product license No. 34-060706-03 was terminated in May, 1982. Licenses TR-3 and R-93 controlled and authorized possession only of the remaining radioactive materials on-site, i.e., no facility operations were permitted until decommissioning was authorized in 2002. During 1973 to 2002, selected equipment, materials, and waste (both low-level radioactive and non-radioactive) were removed to other locations or discarded as the projected long-term considerations for the facility changed from possible restart to standby to decommissioning. For a brief history of the activities during this period see the NASA PBRF Decommissioning Plan, Section 1.2.1 Decommissioning Historical Overview [NASA 2007a].

Two radiological characterization efforts were conducted at PBRF during the post shutdown period prior to active decommissioning. A 1985 characterization survey performed by Teledyne Isotopes, Inc. covered the buildings and grounds at PBRF that were thought to be likely contaminated. The ROLB floors and inside wall surfaces at all elevations, including basements, were surveyed. In 1998, GTS Duratek conducted a confirmatory radiological survey on portions of PBRF to support planning for decommissioning and license termination activities. In this survey, only the easily detected radionuclides were analyzed in various

material samples and quantified by gamma spectroscopy. A summary of the 1985 study indicated that removable surface alpha contamination in the ROLB ranged from 0 to 4 dpm/100-cm^2. Removable surface beta-gamma contamination ranged from 0 to 137 dpm/100-cm^2, and direct radiation levels averaged less than 0.02 mR/hr.

The 1998 confirmatory study generally confirmed the 1985 Teledyne results. In this survey 120 direct beta measurements were performed and 120 smears collected in the building. However, additional contamination in four ROLB laboratories (Rooms 207, 209, 210 and 213A) was measured. Direct beta contamination levels of up to 68,000 dpm/100-cm^2 were measured (the four highest measurements were: 6,100, 9300, 49,000 and 68,000 dpm/100-cm^2). All the remaining direct beta measurements were less than 2,000 dpm/100-cm^2). Of the removable surface alpha activity results, three of 120 measurements were > MDA (MDAs were 7 to 8 dpm/100-cm^2). The positive results were: 70, 118 and 162 dpm/100-cm^2. All beta removable surface activity measurements were < MDA (14 dpm/100-cm^2).

3.4 Decommissioning

After NRC approval of the Decommissioning Plan in 2002, the ROLB was cleared of readily removable items such as desks, storage cabinets, and laboratory equipment (hoods, analytical equipment, etc.). Most piping, pumps and HVAC equipment were removed. This included waste disposal of radioactively contaminated items.

In addition to removal of bulk equipment and furnishings, D&D activities focused on decontamination of known contaminated areas identified in the initial decommissioning characterization surveys. Also, surface coverings and fixtures that could mask contamination or physically interfere with surface activity measurements were removed. This included floor tiles, ceiling acoustic tile and wall coverings. Hazardous materials and many building features, except structural components, have been removed from the building to facilitate the Final Status Survey. Recyclable items were segregated where possible.

Radiological surveys were performed throughout the decommissioning process. The objective of the final post-remediation survey was to ensure that the ROLB could satisfy the release criteria with a high probability of success. A summary of the areas in the ROLB where contamination was measured and remediated during D&D is provided in Table 2. These results do not include surveys of contaminated equipment or bulk contaminated items that were removed and disposed of as radioactive waste.

Table 2, Contaminated Areas Identified in ROLB Decommissioning Surveys

Room No. or Location	Contamination levels	Radionuclides Measured	Results, Survey ID Date (Month-Year)
New Fuel Vault	Up to 36,000 dpm/100-cm^2 alpha	Co-60, Cs-137 & U-235(γ spec. of smears)	MWH C1141 206C1, Oct-03, Remediated [2]
New Fuel Vault	9 of 24 alpha measurements > 200 dpm/100-cm^2	No sample analysis reported	MWH C1141 206C2, -Feb-04, Widespread alpha contamination Remediated [2]
Basement level Men's room	Up to 39,000 dpm/100-cm^2 beta	No sample analysis reported	MWH C1141 206C1, Oct-03
Basement level Men's room	Up to 34,000 dpm/100-cm^2 beta	No sample analysis reported	SR-31 Oct-06, post remediation survey, Remediated [2]
Second Floor E-W Hallway labs and offices [1]	Up to 251,000 dpm/100-cm^2 beta	Co-60, Nb-94, Cs-137, U-235 (Gamma spec. of smears)	MWH C1141 214C1, Sep-03
Second Floor E-W Hallway labs and offices [1]	Up to 297,000 dpm/100-cm^2 beta, Up to 4900 dpm/100-cm^2 alpha	No sample analysis reported	MWH C1141 214C2, Nov-04, Remediated [2]
Room 210	Up to 9900 dpm/100-cm^2 beta	No sample analysis reported	SR-31 Oct-06, post remediation survey, Remediated [2]
Southeast Stairwell	6400 dpm/100-cm^2 (spot on 3rd step above 1st floor foyer)	No sample analysis reported	MWH C1141 205C1, Oct-04, Remediated

Table 2 Notes:

1. Alpha and beta surface contamination was measured in Rooms 207, 209, 210, 211, 213A, 214 and 215.
2. Remediation goals varied somewhat through the decommissioning period, but were generally lowered to < 5500 dpm/100-cm^2 total surface beta activity and < 20 dpm/100-cm^2 total surface alpha activity during final post-remediation surveys.

4.0 Survey Design and Implementation for the ROLB

This section describes the method for determination of the number of fixed measurements and samples for the FSS of the ROLB. Requirements of the FSS Plan applicable to the ROLB are summarized. These include the $DCGL_W$[7], the gross activity DCGL that applies to the ROLB, scan survey coverage and action-investigation levels, classification of areas and breakdown of the ROLB survey units. The radiological instrumentation and their detection sensitivities are discussed.

[7] The convention used in the MARSSIM is to identify the DCGL used as the benchmark for evaluating survey unit measurement results, as the $DCGL_W$. The "W" subscript denotes "Wilcoxon", regardless of the particular test used (Wilcoxon Rank Sum Test, or Sign Test).

4.1 FSS Plan Requirements

The DCGLs for individual radionuclides were obtained for PBRF structures considering exposure to future site occupants from two potential pathways. Single radionuclide DCGLs were calculated using RESRAD-BUILD Version 3.22 for a building reuse scenario. Single radionuclide volumetric DCGLs were calculated for subsurface structures using RESRAD Version 6.21 for a resident farmer scenario.[8] The volumetric DCGLs (in pCi/g) were converted to "effective surface" DCGLs (in dpm/100-cm^2) using surface-to–volume ratios for the assumed volume of contaminated subsurface concrete. The DCGL calculations are described in the FSSP, Attachment B. To obtain the DCGLs for PBRF structures, the smaller of the two DCGLs calculated for each of the radionuclides of concern were selected.

For structural surfaces in the PBRF, where multiple radionuclides are potentially present in residual contamination, the DCGL for FSS design and implementation is a gross activity DCGL. The gross activity DCGL accounts for the presence of multiple radionuclides, including beta-gamma and alpha emitters. The gross activity DCGL can also include so-called hard-to-detect (HTD) radionuclides. The latter are not detected, or detected with very low efficiency, by the beta detectors selected for the FSS of structures.

The gross activity DCGL for the ROLB is calculated using equations in the FSSP for gross beta, gross alpha and surrogate DCGLs, based on the radionuclide mixture in residual contamination. Activity fractions and gross activity DCGLs for the ROLB are shown in Table 3. The default DCGL for PBRF structures, 27,166 dpm/100-cm^2, is applied to the ROLB.

Table 3, ROLB Radionuclide Activity Fractions and Gross Activity DCGLs

Location	Radionuclides								$DCGL_W$ (dpm/100 cm^2)
	H-3	Co-60	Sr-90	I-129	Cs-137	Eu-154	U-234	U-235	
	Activity Fractions Assigned to ROLB [1]								
New Fuel Vault [2]	0.3902	0.0076	0.0421	0.0287	0.1755	0	0.3438	0.0121	30,831
All Other Rooms	0.2707	0.0965	0.0788	0.0142	0.4671	0.0012	0.0698	0.0017	27,166

Table 3 Notes:

1. Activity profiles and gross activity DCGLs for structures are reported in the Technical Basis Document PBRF-TBD-07-001 [PBRF 2007]. Only a small fraction of characterization smear and material samples from the ROLB showed detectable activity. Thus, the ROLB was assigned the default radionuclide mixture using fractions obtained as the averages of the radionuclide activity fractions in 18 characterization samples.
2. For conservatism, the default DCGL, 27,166 dpm/100-cm^2, was used in the survey design for the New Fuel Vault.

[8] Potential exposure to future occupants from subsurface structures could occur from contaminated concrete rubble placed as fill and from contaminated intact structures such as the below-grade portion of the Reactor Bioshield

Survey designs must incorporate requirements for scan coverage and investigation levels derived from the MARSSIM classification of survey units. The values applicable to the ROLB are shown in Table 4.

Table 4, Class-Based Survey Scan Coverage and Action Level Requirements

Classification	Scan Survey Coverage	Scan Investigation Levels	Static Measurement or Sample Result Investigation Levels
Class 1	100%	$>DCGL_{EMC}$	$>DCGL_{EMC}$
Class 2	10 to 100%	$>DCGL_W$ or $>MDC_{scan}$ if MDC_{scan} is $>DCGL_W$	$>DCGL_W$
Class 3	Minimum of 10%	$>DCGL_W$ or $>MDC_{scan}$ if MDC_{scan} is $>DCGL_W$	$\geq$50% of the $DCGL_W$

4.2 Area Classification and Survey Unit Breakdown

The ROLB was divided into 87 areas for division into potential survey units and assigned initial MARSSIM classifications in the FSS Plan. This breakdown is shown in Table 2-1 of the FSS Plan. As part of the FSS implementation process, individual survey units are identified and their final MARSSIM classification established. The ROLB was divided into 60 survey units for the FSS. The 60 survey units comprise 59 structure survey units and one surface soil survey unit. Table 5 lists the individual survey units and their classification for the FSS. The table compares final classification of the survey units with FSS Plan Table 2-1 classifications. Table 5 was reviewed to ensure that no areas were classified "downward" from classifications assigned in the FSS Plan. Table 6 summarizes the survey unit breakdown by major elevation. Table 7 shows the survey unit breakdown by MARSSIM classification. [9]

Table 5, ROLB Survey Units for FSS

Survey Unit (1)	**Class**	**Description** (Rm=Room; Fl=Floor; Lw=Lower wall; Uw=Upper wall; Wl=Window ledges)	**FSSP Classification** (2) (3)
RO-1-1	1	Rm 117/118 – Fl	1
RO-1-2	1	Rm 117/118 – Lw, Wl	1
RO-1-3	1	Rms119/120 – Fl	1
RO-1-4	1	Rm 119/120 – Lw, Wl	1
RO-1-5	2	Rm 109 - 111 Fl, Lw, Wl, Rm112 - 116 Fl, Lw, Uw, Wl. Rm 117-120 Uw	2
RO-1-6	2	Rm 121 – 126 Fl, Lw, Wl, Restrooms, Closets, Phone Booth Fl, Lw, Uw	2
RO-1-7	2	N.E. Stairwell Fl, Lw, Uw, Ceiling S.E. Stairwell Fl, Lw, Uw, Ceiling	2
RO-1-8	2	East/West Hallway Fl, Lw, Uw	2

[9] The calculations performed in preparation of this report are documented in a memorandum to the PBRF Decommissioning Project File [PBRF 2010].

Table 5, ROLB Survey Units for FSS

Survey Unit (1)	Class	Description (Rm=Room; Fl=Floor; Lw=Lower wall; Uw=Upper wall; Wl=Window ledges)	FSSP Classification (2) (3)
RO-1-9	2	Rm 112-120, restrooms, closet, pipe chase, E.-W. Hallway Ceiling	2
RO-1-10	3	North/South Hallway Fl, Lw, Uw	3
RO-1-11	3	Lobby, Rm100-108 Fl, Lw, Uw, Wl, Rm109-111, Rm 121-126 Uw	3
RO-1-12	3	Lobby, Rm100-111, Rm 121-126, North/South Hallway Ceiling	3
RO-2-1	1	Room 207/207A/EW Hall Fl	1
RO-2-2	1	Room 209-210 Fl	1
RO-2-3	1	Room 211/212 Fl	1
RO-2-4	1	Room 213/213A Fl	1
RO-2-5 (4)	1	Room 214/215/NS Hall Fl	Rms 215/215 = 1, NS Hall =3
RO-2-6 (4)	1	EW Hall Fl	2
RO-2-7 (4)	1	Laboratory Area Columns	NC
RO-2-8	1	Wall Section 1 - Room 207/207A Walls Lw, Uw, Wl	1
RO-2-9	1	Wall Section 2 - Room 207/207A/209/210/EW Hall Lw, Uw, Wl	1
RO-2-10	1	Wall Section 3 - Rooms 211-213/213A N Wall Lw, Uw, Wl	1
RO-2-11	1	Wall Section 4 - Rooms 213A/214/215 West Wall Lw, Uw, Wl	1
RO-2-12 (4)	1	Wall Section 5 - Room 215, NS Hall walls Lw, Uw	Rm 215 = 1, NS Hallway = 3
RO-2-13	1	Room 207/207A/East-West Hall Ceiling	1
RO-2-14	1	Room 209-210 Ceiling	1
RO-2-15	1	Room 211/212 Ceiling	1
RO-2-16	1	Room 213/213A Ceiling	1
RO-2-17	1	Room 214/215/NS Hall Ceiling	1
RO-2-18	1	EW Hall Ceiling	1
RO-2-19	2	Class 2 areas Fl, Lw, Uw, Wl, Ceiling	2
RO-2-20	3	Class 3 areas Fl, Lw, Uw, Wl	3
RO-2-21	3	Class 3 areas Ceiling	3
RO-2-22	1	Class 1 Ceiling Beams Ceiling	1
RO-2-23	1	Class 1 Ceiling Beams Ceiling	1
RO-3-1	1	Area Way Fl	1
RO-3-2	1	Vestibule, Men's Room, Janitor Closet. Cold Test Area (west) Fl	1
RO-3-3	1	Cold Test Area (center) Fl	1
RO-3-4	1	Cold Test Area (east) and Vault Fl	1
RO-3-5	1	Sump Room, Sumps, Elevator Sump Fl	
RO-3-6	1	Sump Room, Men's Room, Janitor Lw	1
RO-3-7	1	Area Way and Vault Lw	1
RO-3-8	1	Cold Test Area and Vestibule Lw	1
RO-3-9	1	Sump Room Ceiling	1
RO-3-10	1	Sump Room Uw and Vestibule, Men's Room, Janitor Ceiling	1
RO-3-11	1	Men's Room, Janitor, and Vault Uw and Vault Ceiling	1
RO-3-12	1	Vestibule Uw and Area Way Ceiling	1
RO-3-13	1	Area Way Uw	1
RO-3-14	1	Cold Test Area and Columns Uw	1
RO-3-15	1	Cold Test Area (North) Ceiling	1
RO-3-16	1	Cold Test Area (North Central) Ceiling	1
RO-3-17	1	Cold Test Area (South Central) Ceiling	1
RO-3-18	1	Cold Test Area (South) Ceiling	1

Table 5, ROLB Survey Units for FSS

Survey Unit (1)	Class	Description (Rm=Room; Fl=Floor; Lw=Lower wall; Uw=Upper wall; Wl=Window ledges)	FSSP Classification (2) (3)
RO-3-25	2	Class 2 Area Ceiling not including the elevator shaft	2
RO-3-26	2	Class 2 Area Ceiling not including the elevator shaft	2
RO-3-27	2	Class 2 Area Ceiling not including the elevator shaft	2
RO-3-28A	3	Crawl Space	3
RO-3-28B (4)	3	Crawl Space Soil	NC
RO-4-1	2	Roof	2
RO-4-2	3	Exterior walls	3

Table 5 Notes:

1. Reduction of 87 areas identified in FSSP Table 2-1 to 60 survey units was achieved by combining multiple areas in the FSS Plan breakdown (classification-based size limits were maintained).
2. The FSS Plan classifications were based on area history and available characterization data.
3. NC means not classified, or not specifically identified in the FSS Plan Table 2-1.
4. Denotes a survey unit whose classification was changed from that listed in the FSSP Table 2-1 or one that was not specifically identified (and classified) in Table 2-1,

Table 6, ROLB Survey Unit Breakdown by Major Elevation

Major Elevation or Area	No. of Survey Units	Surface Area (m^2)	% of Survey Units	% of Surface Area
1st Floor	12	5295	20.0	32.2
2nd Floor	23	3940	38.3	24.0
Basement (1)	23	4637	38.3	28.2
OW&R (2)	2	2558	3.3	15.6
Total	60	16430	100	100

Table 6 Notes:

1. The basement survey units include one survey unit that is not a structure. RO-3-28B Crawl Space (soil). The surface area of this survey unit, 348.4 m^2, is included in the total surface area, 16430 m^2.
2. OW&R – outside walls and roof.

Table 7, ROLB Survey Unit Breakdown by MARSSIM Classification

Class	No. of Survey Units	Surface Area (m^2)	% of Survey Units	% of Surface Area	Average Area of Survey Units (m^2)
1	42	3061	70.0	18.6	72.9
2	10	6826	16.7	41.5	682.6
3	8	6543	13.3	39.8	817.9
Total	60	16430	100	100	

4.3 Number of Measurements and Samples

The number of measurements and samples for each ROLB survey unit was determined using the MARSSIM statistical hypothesis testing framework as outlined in the FSS Plan. The Sign Test is selected because background count rates of instruments to be used are equivalent to a small fraction of the applicable $DCGL_W$.[10] Decision error probabilities for the Sign Test are set at $\alpha = 0.05$ (Type I error) and $\beta = 0.10$ (Type II error) in accordance with the FSSP.

The Visual Sample Plan (VSP) software was used to determine the number of FSS measurements in the ROLB. [11] When the Sign Test is selected, the VSP software uses MARSSIM Equation 5-2 to calculate the number of measurements. Equation 5.2 is shown below:

$$N = 1.2\frac{\left(Z_{1-\alpha} + Z_{1-\beta}\right)^2}{4\left[\Phi\left(\frac{\Delta}{\sigma}\right) - 0.5\right]^2} \qquad \textbf{(Equation 1)}$$

Where:

1.2 = adjustment factor to add 20% to the calculated number of samples, per a MARSSIM requirement to provide a margin for measurement sufficiency,
N = Number of measurements or samples,
α = the type I error probability,
β = the type II error probability,
$Z_{1-\alpha}$ = proportion of standard normal distribution $< 1 - \alpha$ (1.6449 for σ = 0.05),
$Z_{1-\beta}$ = proportion of standard normal distribution $< 1 - \beta$ (1.2816 for $\beta = 0.1$),
$\Phi\ (\Delta/\sigma)$ = value of cumulative standard normal distribution over the interval $-\infty, \Delta/\sigma$,
Δ = the "relative shift", defined as the DCGL – the Lower Bound of the Gray Region (LGBR), and
σ = the standard deviation of residual contamination in the area to be surveyed (or a similar area). This may include the variation in measured "ambient" background plus the material background (for total surface beta measurements).

[10] Background count rates for the LMI 44-116 detector, the instrument of choice for FSS surface beta activity measurements on structures, are in the range of 300 cpm or less for most materials. This is equivalent to about 2500 dpm/100-cm^2; less than 10% of PBRF structure DCGLs (this assumes a detection efficiency of ~ 12%).

[11] The FSS Plan (Section 5.2.4) states that a qualified software product, such as Visual Sample Plan© [PNL 2010], may be used in the survey design process.

The MARSSIM module of VSP requires user inputs for the following parameters: α, β, Δ, σ and the $DCGL_W$. The number of measurements, N, for the 60 ROLB survey units were calculated in 10 survey designs. Table 8 summarizes the ROLB survey design calculations and lists the values of the key VSP input parameters.

Table 8, ROLB Survey Design Summary

Design No. (1)	Survey Units	Class	DCGL (2)	LGBR (2)	Δ (2)	σ (2) (3)	Δ/σ	N
1	RO-1-1 through RO-1-4	1	27,166	25,920	1,246	415	3.0	11
2	RO-1-5 through RO-1-9	2	27,166	25,920	1,246	415	3.0	11
3	RO-1-10 through RO-1-12	3	27,166	25,920	1,246	415	3.0	11
4	RO-2-1 through RO-2-18, RO-2-22 & RO-2-23	1	27,166	24,987	2,179	726	3.0	11
5	RO-2-19	2	27,166	24,987	2,179	726	3.0	11
6	RO-2-20 & RO-2-21	3	27,166	24,987	2,179	726	3.0	11
7	RO-3-1 through RO-3-18	1	27,166	11,261	15,905	5,302	3.0	11
8	RO-3-25 through RO-3-27	2	27,166	11,261	15,905	5,302	3.0	11
9	RO-3-28A &RO-3-28B	3	27,166	11,261	15,905	5,302	3.0	11
9	RO-3-28B (soil) (4)	3	388	312	76	25	3.0	11
34	RO-4-1 & RO-4-2 (5)	2,3	24,449	12,225	12,224	4,890	2.5	11

Table 8 Notes:

1. The data reported in Table 8 is taken from the Survey Design reports listed. They are maintained in the PBRF Document Control System.
2. Units are dpm/100-cm^2, except in Survey Design No. 9, where the units are cpm.
3. Estimates of σ are obtained from ROLB post-remediation and variability survey (SR-31) and MWH characterization survey material background study (G9000 401B1) measurements collected with LMI 44-116 beta detectors.
4. Survey design inputs for the ROLB Crawl Space soil survey unit (Design No.9) were derived from DCGLs expressed as soil activity concentrations in pCi/g. The gross activity soil DCGL was calculated to be 11.7 pCi/g. This considers the DCGLs for Cs-137, Sr-90 and Co-60, with Cs-137 used as the surrogate for Sr-90. The equivalent DCGL in net cpm for the LMI 44-10 NaI detector was calculated to be 388 cpm and the standard deviation of NaI measurements was estimated to be 25 cpm.
5. In Survey Design No. 34, survey units RO-4-1 and RO-4-2 (building exterior surfaces), the $DCGL_W$, 24,449 dpm/100-cm^2, was obtained by adjusting the default value, 27,166 dpm/100-cm^2, by a factor of 10% (2.5/25) to account for deselected "insignificant" radionuclides.

Selection of design input parameters followed guidance in the FSS Plan. The Plan states that "the LGBR is initially set at 0.5 times the $DCGL_W$, but may be adjusted to obtain a value for the relative shift (Δ/σ) between 1 and 3." It is seen in Table 8, that in the majority of ROLB designs, a relative shift value of 3.0 was used in the final calculations for determining N.

The VSP software automatically performs an analysis to examine the sensitivity of N, the number of samples, to critical input parameter values. The following is an example obtained from the VSP report for survey unit RO-2-1 in Design No. 4. The sensitivity of N was explored by varying the following parameters: standard deviation, lower bound of gray region (as % of DCGL), beta, probability of mistakenly concluding that the survey unit mean concentration, μ, is greater than the DCGL and alpha, probability of mistakenly concluding that the survey unit mean concentration, μ, is less than the DCGL. Table 9 summarizes this analysis. The region of critical sensitivity is for $\alpha = 0.05$ (required to be fixed), $\beta = 0.10$ (may be adjusted) and the LGBR set equal to 90% of the DCGL. In this region, N is only moderately sensitive to an increase of 100% in the value of σ. In this case, N changes from 11 to 12. The sensitivity of N to an incorrect conclusion that the survey unit will pass (regulator's risk) is quite low; increasing α from 0.05 to 0.10 and 0.15 shows that the number of measurements is 11 or fewer in all cases except one. These results show that N = 11 represents a conservative design.

Table 9, VSP Sensitivity Analysis Results for Survey Unit RO-2-1 Design

Number of Samples							
DCGL=27,166 (1)		α=0.05 (2)		α=0.10		α=0.15	
		σ=1,452 (1) (3)	σ=726	σ=1,452	σ=726	σ=1,452	σ=726
LBGR=90% (1) (4)	β=0.05 (5)	16	14	12	11	11	10
	β=0.10	12	11	10	9	9	8
	β=0.15	11	10	9	8	6	6
LBGR=80%	β=0.05	14	14	11	11	10	10
	β=0.10	11	11	9	9	8	8
	β=0.15	10	10	8	8	6	6
LBGR=70%	β=0.05	14	14	11	11	10	10
	β=0.10	11	11	9	9	8	8
	β=0.15	10	10	8	8	6	6

Table 9 Notes:
1. Units of DCGL, σ and LGBR are dpm/100-cm^2.
2. α = alpha, probability of mistakenly concluding that $\mu <$ DCGL.
3. σ = Standard Deviation.
4. LBGR = Lower Bound of Gray Region (as % of DCGL)
5. β = beta, probability of mistakenly concluding that $\mu >$ DCGL

Visual Sample Plan was also used to determine the grid size, the random starting location coordinates (for Class 1 and 2 survey units) and to display the measurement locations on survey unit maps drawn to scale. Refer to Appendix B for location coordinate tables and scale VSP maps showing measurement locations for each ROLB survey unit.

The survey designs also specify scan survey coverage and action levels based on the MARSSIM classification listed in Table 4. If the scan sensitivity of the detectors used in Class 1 survey units is below the $DCGL_W$, the number of measurements in each survey unit is

determined solely by the Sign Test. If the scan sensitivity is not below the $DCGL_W$, the number of measurements is increased as determined by the Elevated Measurement Test. As discussed in the next section, the scan sensitivities of instruments used in the FSS of the ROLB are below the $DCGL_W$, and no increase in the number of measurements calculated using the Sign Test was required.

4.4 Instrumentation and Measurement Sensitivity

Instruments to be used in the FSS of each survey unit are selected in each survey design. Their detection sensitivities must be sufficient to meet the required action levels for the MARSSIM class of each survey unit. Minimum detection sensitivities for static alpha and beta measurements are calculated using the following equation:

$$MDCstatic = \frac{3 + 3.29\sqrt{B_R t_s (1 + \frac{t_s}{t_b})}}{t_s E_{tot} \frac{A}{100}}, \qquad \textbf{(Equation 2)}$$

where:

MDC_{static} = Minimum Detectable Concentration (dpm/100-cm^2),

B_R = Background Count Rate (cpm),

t_b = Background Count Time (min),

t_s = Sample Count Time (min),

A = Detector Open Area (cm^2) and

E_{tot} = Total Detection Efficiency (counts per disintegration). The total efficiency equals the product of Detector Efficiency, E_i and Surface Efficiency, E_s.

Scan sensitivities for detectors which measure alpha and beta surface activity are determined using the following equation:

$$MDCscan = \frac{d'\sqrt{b_i}\frac{60}{i}}{E_i E_s \sqrt{p}\frac{A}{100}}, \qquad \textbf{(Equation 3)}$$

Where:

MDC_{scan} = Minimum Detectable Concentration (dpm/100-cm^2),

d' = Index of sensitivity related to the detection decision error rate of the surveyor, from Table 6.5 of MARSSIM [USNRC 2000],

i = observation counting interval, detector width (cm) / scan speed (s),

b_i = background counts per observation interval,

E_i = Detector Efficiency (counts per disintegration),

Es = Surface Efficiency, typically 25% for alpha and 50% for beta (ISO 7503-1, Table 2 [ISO 1988],

p = Surveyor efficiency (typically 50%) and

A = Detector Open Area (cm^2).

In accordance with the FSS Plan, scan sensitivities of NaI detectors for surface scans of soil and outdoor areas may be obtained from Table 6.7 of the MARSSIM [USNRC 2000]. For conditions other than those covered in the MARSSIM table, a modified form of Equation 3 is used.

A summary of the a' priori detection sensitivities of instruments used in the FSS of the ROLB is provided in Table 10.

Table 10, Detection Sensitivities of Field Instruments

Detector Model	Detector Efficiency (c/d) [1]	MDC_{scan} (dpm/100-cm^2) [2] [3]	Net cpm Equivalent to MDC_{scan}	MDC_{static} (dpm/100-cm^2)
LMI 44-116 [4] [5]	0.12	2336	188	616
LMI 43-37 [6]	0.145	798	352	NA
LMI 44-10 [7]	NA	3.47	388	NA

Table 10 Notes:

1. The detector efficiencies listed are total efficiency, i. e., $E_t = E_i + E_s$.
2. A' priori scan sensitivities for the LMI 44-116 & LMI 43-37 detectors are calculated using Equation 3.
3. The scan MDC for NaI detector is in units of pCi/g (Cs-137). The instrument is set up using an energy window to count only gamma rays centered on the Cs-137 660 kev photopeak.
4. The static MDC for the LMI 44-116 detector is calculated using Equation 2 with background count rate = 236 cpm, $E_i = 0.242$ and $E_s = 0.5$ (detector-to-surface distance = 0.5 in.)
5. The scan MDC for the LMI 44-116 is from Survey Design No.1, Att. 5-2. The background count rate is 236 cpm; scan speed is 10 cm/s, $E_i = 0.242$, $E_s = 0.5$, efficiency correction factor = 0.8349 to compensate for concrete roughness (detector-to-surface distance 0.5 in.)
6. The scan MDC for the LMI 43-37 is from Survey Design No.1, Att. 5-3. The background count rate is 483 cpm; scan speed is 30 cm/s, $E_i = 0.29$, $E_s = 0.5$, detector-to-surface distance 0.5 in.
7. The scan MDC for the LMI 44-10 is obtained from Survey Design No. 73, Att. 5-4, with a background count rate of 130 cpm (Cs-137 window) and a scan speed of 25 cm/s.

Modifications to survey instructions are adjusted to account for unusual measurement conditions. Modified detection sensitivities may be applied taking into account adjustments in detector efficiency. Scan speeds may be reduced to ensure that required scan sensitivities are achieved. The bases for adjustments due to non-standard conditions are provided in PBRF Technical Basis Documents.[12] Examples of areas or locations in ROLB survey units where special measurement conditions apply are shown in Exhibits 14 and 15 of Appendix A.

5.0 ROLB Survey Results

Results of the ROLB FSS are presented in this section. This includes scan survey frequencies (% of areas covered) for each survey unit and occurrence of events where scan investigation levels were exceeded. Investigations performed and the results are summarized. Fixed measurement results for each survey unit and the results of comparison tests of survey unit maximum and average values with the $DCGL_W$ are reported. As discussed below, no statistical tests were required. It is shown that levels of residual contamination have been reduced to levels that are ALARA. Soil activity concentrations are compared to EPA trigger levels in accordance with the 2002 Memorandum of Understanding between the NRC and EPA [USEPA 2002]. This section closes with a summary which concludes that applicable criteria for release of the ROLB for unrestricted use are satisfied and all FSS Plan requirements are met.

5.1 Surveys and Investigations

Scan survey results were reviewed to confirm that the scan coverage requirement (as % of survey unit area) was satisfied for all survey units. The results of QC replicate surveys were also reviewed to confirm that the minimum coverage requirement of 5% was satisfied. Results of the ROLB scan surveys are compiled in Table 11. The table shows that scan coverage requirements were satisfied for all survey units. The table also shows that scan investigation levels were exceeded in two survey units (both Class 1). The results of the investigations are summarized below.

[12] The PBRF-TBD-07-004 [PBRF 2007a] presents efficiency correction factors developed for the LMI 44-116 detector. The correction factors are presented as a function of detector-to-surface distance. Application of the factors requires empirical measurements of the effective detector-to-surface distance for areas with non-standard surface conditions as part of the survey unit inspection process. The PBRF-TBD-09-002 [PBRF 2009a] calculates LMI 44-10, NaI detector scan MDC values for various survey conditions, including non-standard sized areas of elevated activity. The PBRF-TBD-09-006 [PBRF 2009b] evaluates the LMI 44-10 response when performing soil scans in water covered areas. It is shown that the effect of water covering the soil scan area can be compensated for by modifying the scan survey technique, primarily by decreasing the detector-to-surface distance.

Table 11, Scan Survey Results

Survey Unit	Class	Scan Survey Coverage (%) (1)	QC Replicate Scan Coverage (%) (1) (2) (3)	Investigation Level Exceeded
RO-1-1	1	100	30	No
RO-1-2	1	100	30	No
RO-1-3	1	100	30	No
RO-1-4	1	100	30	No
RO-1-5	2	53	16	No
RO-1-6	2	56	6	No
RO-1-7	2	53	15	No
RO-1-8	2	52	7	No
RO-1-9	2	51	9	No
RO-1-10	3	26	13	No
RO-1-11	3	14	7	No
RO-1-12	3	11	8	No
RO-2-1	1	100	21	No
RO-2-2	1	100	21	Yes
RO-2-3	1	100	21	No
RO-2-4	1	100	21	No
RO-2-5	1	100	21	No
RO-2-6	1	100	21	No
RO-2-7	1	100	7	No
RO-2-8	1	100	7	No
RO-2-9	1	100	7	No
RO-2-10	1	100	7	No
RO-2-11	1	100	7	No
RO-2-12	1	100	7	No
RO-2-13	1	100	6	No
RO-2-14	1	100	6	No
RO-2-15	1	100	6	No
RO-2-16	1	100	6	No
RO-2-17	1	100	6	No
RO-2-18	1	100	6	No
RO-2-19	2	51	8	No
RO-2-20	3	12	12	No
RO-2-21	3	12	18	No
RO-2-22	1	100	6	No
RO-2-23	1	100	6	No
RO-3-1	1	100	10	No
RO-3-2	1	100	10	No
RO-3-3	1	100	10	No
RO-3-4	1	100	10	No
RO-3-5	1	100	10	No
RO-3-6	1	100	6	No
RO-3-7	1	100	6	No
RO-3-8	1	100	6	No
RO-3-9	1	100	6	No
RO-3-10	1	100	6	No
RO-3-11	1	100	6	No
RO-3-12	1	100	6	No
RO-3-13	1	100	6	No
RO-3-14	1	100	6	Yes

Table 11, Scan Survey Results

Survey Unit	Class	Scan Survey Coverage (%) (1)	QC Replicate Scan Coverage (%) (1) (2) (3)	Investigation Level Exceeded
RO-3-15	1	100	6	No
RO-3-16	1	100	6	No
RO-3-17	1	100	6	No
RO-3-18	1	100	6	No
RO-3-25	2	65	8	No
RO-3-26	2	55	8	No
RO-3-27	2	52	8	No
RO-3-28A	3	13	7	No
RO-3-28B	3	13	8	No
RO-4-1	2	53	5	No
RO-4-2	3	11	7	No

Table 11 Notes:

1. Scan % coverage values are rounded to the nearest whole per cent. Values reported with the first decimal as 5, e. g., 5.5, are rounded downward.
2. The % scan coverage is given as the % of the area scanned in the initial survey.
3. Replicate QC scan results are reported for multiple survey units in many Survey Requests. The QC scan percentages are reported as % of the scanned area of the survey units combined. So the same % coverage value is assigned to all of the survey units reported in a Survey Request..

Review of ROLB release records indicates that during the FSS of the ROLB, investigations were performed in two survey units. In survey unit RO-2-2, Rooms 209-210, Laboratory area floors, a class 1 survey unit, two localized areas were observed to have activity above background during the scan survey. The areas were bounded and investigations performed of each.

The first location, designated as IM-1, was found to contain fixed activity with measured gross surface activity of 13,465 dpm/100-cm^2. This is well below the $DCGL_W$ (27,166 dpm/100-cm^2), and no further action was required.

The second location investigated in RO-2-2, designated as IM-2, was found to consist of a small area of fixed activity < 2x2 cm in area. A static measurement with an LMI 44-116 detector recorded 54,477 dpm/100-cm^2. The EMC test was performed by comparing this measurement to the a'priori $DCGL_{EMC}$, 82,708 dpm/100-cm^2, established in the survey design for this survey unit. A core bore sample was collected that encompassed this small area of elevated activity. The core was cut into one-half inch slices, which were analyzed by gamma spectroscopy. Only the top slice showed measured activity concentrations above the MDA for Cs-137. The concentrations of two measurements (top surface and bottom surface facing the detector) were 616 and 387 pCi/g, respectively. Both slices were < MDA for Co-60 (1.7E-01 pCi/g). Scans of the bore hole and the floor in the vicinity after removal of the core indicated no activity above background. From this result and the success in passing the EMC test, it was concluded that no further action was required.

The release record for survey unit RO-3-14, Cold Test Area upper walls, a class 1 survey unit, also reported an investigation. A scan alarm was observed on the top of an upper wall surface.

A small area, less than a detector area (125 cm^2), was defined and a direct measurement yielded 15,900 dpm/100-cm^2, well below the $DCGL_W$. No further action was required.

As both of these survey units were class 1, no reclassification was required as a result of these investigations.

5.2 Fixed Measurements and Tests

Results of the assessment of ROLB FSS total surface beta measurements are presented in Table 12 (individual measurements in each survey unit are reported in Appendix B). The table presents the number of measurements, maximum, average and standard deviation for each survey unit. Table 12 compares the maximum activity measured in each survey unit to the $DCGL_W$. It is demonstrated that that all measured activity values are less than the $DCGL_W$, thus all survey units meet the 25 mrem/y release criterion. The mean activity of each survey unit is also compared to the DCGLw, and as expected, are all less than the $DCGL_W$. The average of 650 total surface beta measurements reported in the ROLB release records is: 503 ± 408 dpm/100-cm^2 (one standard deviation) [PBRF 2010]. [13]

Removable surface activity measurements were also performed at each fixed activity measurement location and counted for gross alpha and gross beta activity. A review of the ROLB Release records was conducted to ensure that all smear counting results were less than 10% of the gross activity DCGL. The requirement for PBRF laboratory smear counting instruments is that the MDAs be < 10% of the applicable gross activity DCGL[14]. Gross beta and gross alpha counts for all ROLB smears were less than MDA.

The survey unit, RO-3-28B, covered surface soil beneath the basement crawl space. This survey unit was designated as class 3. Eleven surface soil samples were collected and analyzed by gamma spectroscopy by the PBRF laboratory. The highest sample activity was 0.12 pCi/g Cs-137, slightly above the MDA; all other sample results were < MDA for all PBRF gamma emitting radionuclides. By considering PBRF soil radionuclide activity ratios, it is determined based on the Cs-137 results, that the Sr-90 DCGL (5.4 pCi/g) is also satisfied.[15]

[13] It is noted that in converting total surface activity measurements in cpm to dpm/100-cm^2, the detector background response from surface materials is not subtracted. As a result, the total surface activity measurement results are biased high.

[14] Typical MDAs for PBRF low background smear counting instruments are 14 dpm for alpha and 18 dpm for beta. Smears cover 100 cm^2, so these MDA values are equivalent to dpm/100-cm^2.

[15] The Sr-90 to Cs-137 activity ratio for soil reported in the FSS Plan is 0.09. Therefore the surrogate DCGL for Sr-90 based on using Cs-137 soil sample measurements is 11.8 pCi/g, obtained using Equation 2.

Table 12, ROLB Total Surface Beta Activity Measurement Summary and Test Results

Survey Unit ID	No. of Measurements	Maximum (1)	Test Result: Maximum < $DCGL_W$	Average (1)	Standard Deviation (1) (2)	Test Result: Average < $DCGL_W$
RO-1-1	11	913	Yes	599	136	Yes
RO-1-2	11	354	Yes	65	182	Yes
RO-1-3	11	890	Yes	634	257	Yes
RO-1-4	11	409	Yes	145	182	Yes
RO-1-5	11	693	Yes	225	282	Yes
RO-1-6	11	2500	Yes	1069	880	Yes
RO-1-7	11	1159	Yes	252	367	Yes
RO-1-8	11	1000	Yes	420	320	Yes
RO-1-9	11	1031	Yes	576	206	Yes
RO-1-10	11	1960	Yes	425	545	Yes
RO-1-11	11	1306	Yes	349	406	Yes
RO-1-12	11	1000	Yes	516	207	Yes
RO-2-1	11	640	Yes	411	231	Yes
RO-2-2	11	1100	Yes	788	160	Yes
RO-2-3	11	1021	Yes	778	151	Yes
RO-2-4	11	728	Yes	295	339	Yes
RO-2-5	11	824	Yes	568	298	Yes
RO-2-6	11	812	Yes	603	235	Yes
RO-2-7	11	890	Yes	658	191	Yes
RO-2-8	11	551	Yes	197	216	Yes
RO-2-9	11	1537	Yes	138	497	Yes
RO-2-10	11	335	Yes	167	139	Yes
RO-2-11	11	293	Yes	125	128	Yes
RO-2-12	11	535	Yes	124	213	Yes
RO-2-13	11	642	Yes	489	96	Yes
RO-2-14	11	1489	Yes	705	360	Yes
RO-2-15	11	1679	Yes	847	514	Yes
RO-2-16	11	1051	Yes	588	277	Yes
RO-2-17	11	708	Yes	516	133	Yes
RO-2-18	11	971	Yes	593	183	Yes
RO-2-19	11	2204	Yes	523	769	Yes
RO-2-20	11	697	Yes	292	335	Yes
RO-2-21	11	908	Yes	680	230	Yes
RO-2-22	11	839	Yes	550	188	Yes
RO-2-23	11	584	Yes	419	123	Yes
RO-3-1	11	1265	Yes	1015	138	Yes
RO-3-2	11	985	Yes	568	348	Yes
RO-3-3 (3)	12	1250	Yes	906	167	Yes
RO-3-4	11	927	Yes	646	170	Yes
RO-3-5	11	1045	Yes	795	211	Yes
RO-3-6	11	1331	Yes	362	348	Yes
RO-3-7	11	1375	Yes	779	339	Yes
RO-3-8	11	694	Yes	293	198	Yes
RO-3-9	11	659	Yes	470	139	Yes

Table 12, ROLB Total Surface Beta Activity Measurement Summary and Test Results

Survey Unit ID	No. of Measurements	Maximum (1)	Test Result: Maximum < $DCGL_W$	Average (1)	Standard Deviation (1)(2)	Test Result: Average < $DCGL_W$
RO-3-10	11	597	Yes	283	166	Yes
RO-3-11	11	1559	Yes	678	474	Yes
RO-3-12	11	659	Yes	116	300	Yes
RO-3-13	11	887	Yes	604	189	Yes
RO-3-14	11	435	Yes	122	166	Yes
RO-3-15	11	690	Yes	448	156	Yes
RO-3-16	11	613	Yes	446	552	Yes
RO-3-17	11	645	Yes	414	159	Yes
RO-3-18	11	573	Yes	344	173	Yes
RO-3-25	11	891	Yes	641	194	Yes
RO-3-26	11	908	Yes	416	352	Yes
RO-3-27	11	1099	Yes	602	271	Yes
RO-3-28A	11	1140	Yes	676	237	Yes
RO-4-1	11	1420	Yes	435	461	Yes
RO-4-2	11	2440	Yes	1208	1077	Yes

Table 12 Notes:

1. The units for: maximum, average and standard deviation are dpm/100-cm^2.
2. Standard deviations of the measurements in each survey unit are reported for comparison to the values used in the survey design (see Table 8). In all the ROLB structural survey units, values of σ obtained from the FSS measurements are less (usually much less) than values used in the survey designs.
3. In the FSS design calculation for survey unit RO-3-3 developed using VSP, 12 fixed measurement locations were established. When "fitting" the calculated grid size onto the survey unit layout, extra measurement locations (grid nodes) are sometimes added.

5.3 ALARA Evaluation

It is shown that residual contamination in the ROLB has been reduced to levels that are ALARA, using a method acceptable to the NRC. The NRC guidance on determining that residual contamination levels are ALARA includes the following:

> "In light of the conservatism in the building surface and surface soil generic screening levels developed by the NRC, NRC staff presumes, absent information to the contrary, that licensees who remediate building surfaces or soil to the generic screening levels do not need to provide analyses to demonstrate that these screening levels are ALARA. In addition, if residual radioactivity cannot be detected, it may be presumed that it had been reduced to levels that are ALARA. Therefore the licensee may not need to conduct an explicit analysis to meet the ALARA requirement."[16]

Screening level values published by the NRC for the mix of radionuclides in structural surface residual contamination potentially present in the ROLB are shown in Table 13. Since

[16] This guidance was initially published in Draft Regulatory Guide DG-4006, but has been reissued in NUREG-1757 Volume 2, Appendix N.

individual radionuclide activity concentrations are not measured in the FSS of structures, a direct comparison of residual contamination levels to screening level values is not possible. A comparison can be made by converting the nuclide-specific screening level values to an appropriate gross activity DCGL. This is accomplished using activity fractions used in development of the ROLB gross activity DCGL. A screening level value that is equivalent to the gross activity DCGL was calculated using the equations in Section 3.6 of the FSS Plan [PBRF 2010]. The activity fractions listed in Table 3 (also shown in Table 13) were used in the calculation. The screening level equivalent DCGL for the ROLB is 1,188 dpm/100-cm^2.

As reported in Section 5.2, the average total surface beta activity measured in the FSS of the ROLB is 503 ± 408 dpm/100-cm^2 (one standard deviation). The upper limit of 95th% confidence interval of this mean value is 534.4 dpm/100-cm^2.[17] This value is well below the screening level gross activity DCGL of 1,188 dpm/100-cm^2.

Applicable NRC surface soil screening values are: Co-60, 3.8; Sr-90, 1.7 and Cs-137, 11 (all in pCi/g). The single ROLB soil sample result that was > MDA was 0.12 pCi/g, Cs-137. Since Cs-137 is the surrogate for Sr-90 and the Sr-90: Cs-137 activity ratio is only 0.09, the activity concentration of Sr-90 is also well below the screening level. Thus all soil sample results are below their respective screening level values. From these comparisons, it is concluded that the ALARA criterion is satisfied.

Table 13, Screening Level Values for ROLB and Radionuclide Activity Fractions

Radionuclide	Screening Level Value (dpm/100-cm^2)	ROLB Activity Fraction (%)
H-3	1.2 E+08 (1)	27
Co-60	7.1E+03 (1)	9.7
Sr-90	8.7E+03 (1)	7.9
I-129	3.5E+04 (1)	1.4
Cs-137	2.8E+04 (1)	46.7
Eu-154	1.2E+04 (2)	0.1
U-234	9.1E+01 (2)	7.0
U-235	9.8E+01 (2)	0.2

Table 13 Notes.
1. Values from NUREG-1757 Vol. 2, Table H.1 [USNRC 2006].
2. Values from NUREG/CR-5512, Vol. 3, Table 5.19 [SNL 1999]. These are 90th percentile values of residual surface activity corresponding to 25 mrem/y to a future building occupant.

[17] The upper limit of the confidence interval, 95th percentile value, is calculated as: UL = mean + 1.96 $\sigma/\sqrt{n}$, where n = 650 measurements.

5.4 Comparison with EPA Trigger Levels

The PBRF license termination process includes a review of residual contamination levels in groundwater and soil, as applicable, in accordance with the October 2002 Memorandum of Understanding (MOU) between the US NRC and the US Environmental Protection Agency (EPA) [USEPA 2002]. Concentrations of individual radionuclides, identified as "trigger levels" for further review and consultation between the agencies, are published in the MOU. The trigger levels applicable to the PBRF for residual soil concentrations of the radionuclides of concern are:

- Co-60, 4 pCi/g,
- Sr-90 (plus daughter activity), 23 pCi/g and
- Cs-137 (plus daughter activity), 6 pCi/g.

For the ROLB soil survey unit, RO-3-28B, only one sample showed positive results (>MDA; the MDA is < 10% of the DCGL). That result was 0.12 pCi/g, Cs-137. This value is well below the EPA trigger level of 6 pCi/g. Since Cs-137 is the surrogate for Sr-90 and the Sr-90: Cs-137 activity ratio is only 0.09, the activity concentration of Sr-90 is also well below the trigger level.

5.5 Conclusions

The results presented above demonstrate that the ROLB satisfies all FSS Plan commitments and meets the release criteria in 10CFR20 Subpart E. The principal conclusions are:

- Scan surveys were performed in all 60 ROLB survey units with scan coverage in excess of the percentage requirements for all three classes of survey units.
- Residual surface contamination above investigation levels was detected in only two of 60 survey units. A small area of elevated activity above the $DCGL_W$ was measured in one survey unit. The EMC test was conducted and was satisfied.
- All total surface activity measurements are less than the applicable $DCGL_W$, 27,166 dpm/100-cm^2, except in one survey unit as noted above.
- All soil sample radionuclide activity concentrations in the single soil survey unit are below their respective $DCGL_W$ values.
- All survey unit mean fixed measurement results (total surface beta activity) are below the $DCGL_W$, hence no statistical tests were required.
- All removable surface activity measurements are less than 10% of the $DCGL_W$.
- Residual surface activity and soil concentration measurement results are shown to be less than NRC screening level values - demonstrating that the ALARA criterion is satisfied.
- Residual activity concentrations measured in the soil survey unit were compared to, and found to be less than EPA trigger levels.

- Only minor changes from what was proposed in the FSS Plan were made – the classification of three survey units was increased above what was proposed in the Plan.
- There were no changes from initial assumptions (in the FSS Plan) regarding the extent of residual activity in the ROLB. Only one measurement in excess of the DCGL occurred (in a class 1 survey unit) and no reclassification of survey units was required as a result of FSS measurements and investigations.

6.0 References

ISO 1988 International Organization for Standardization, *Evaluation of Surface Contamination, Part 1: Beta Emitters and Alpha Emitters,* ISO-7503-1, 1988.

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USEPA 2002 Memorandum of Understanding, US Environmental Protection Agency and US Nuclear Regulatory Commission, *Consultation and Finality on Decommissioning and Decontamination of Contaminated Sites*, October 9, 2002.

7.0 Appendices

Appendix A – Exhibits

Appendix B – Survey Unit Maps and Tables Showing Measurement Locations and Results

Final Status Survey Report

Attachment 1

Reactor Office and Laboratory Building (Building 1141)

Revision 0

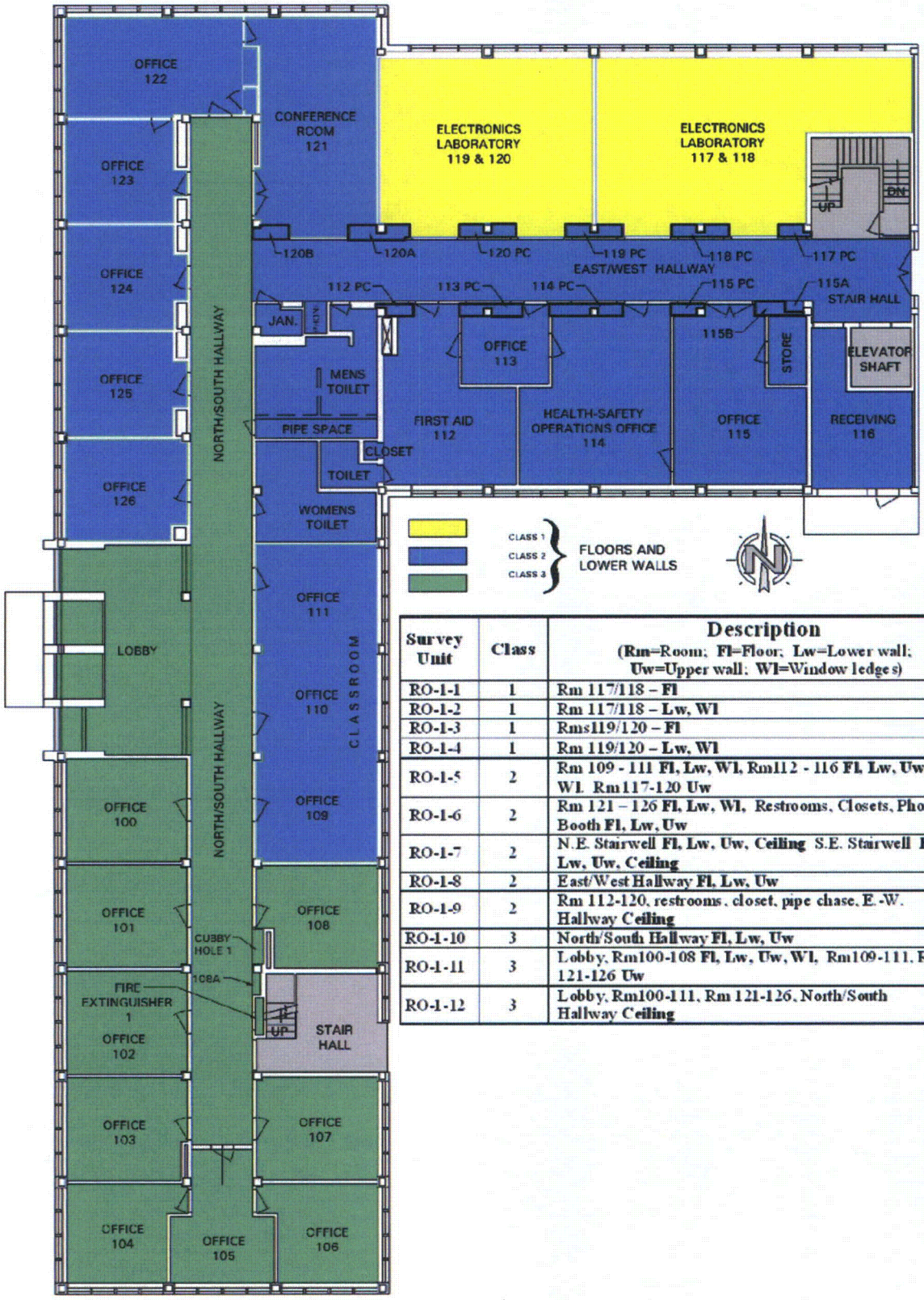
Appendix A

Exhibits

List of Exhibits

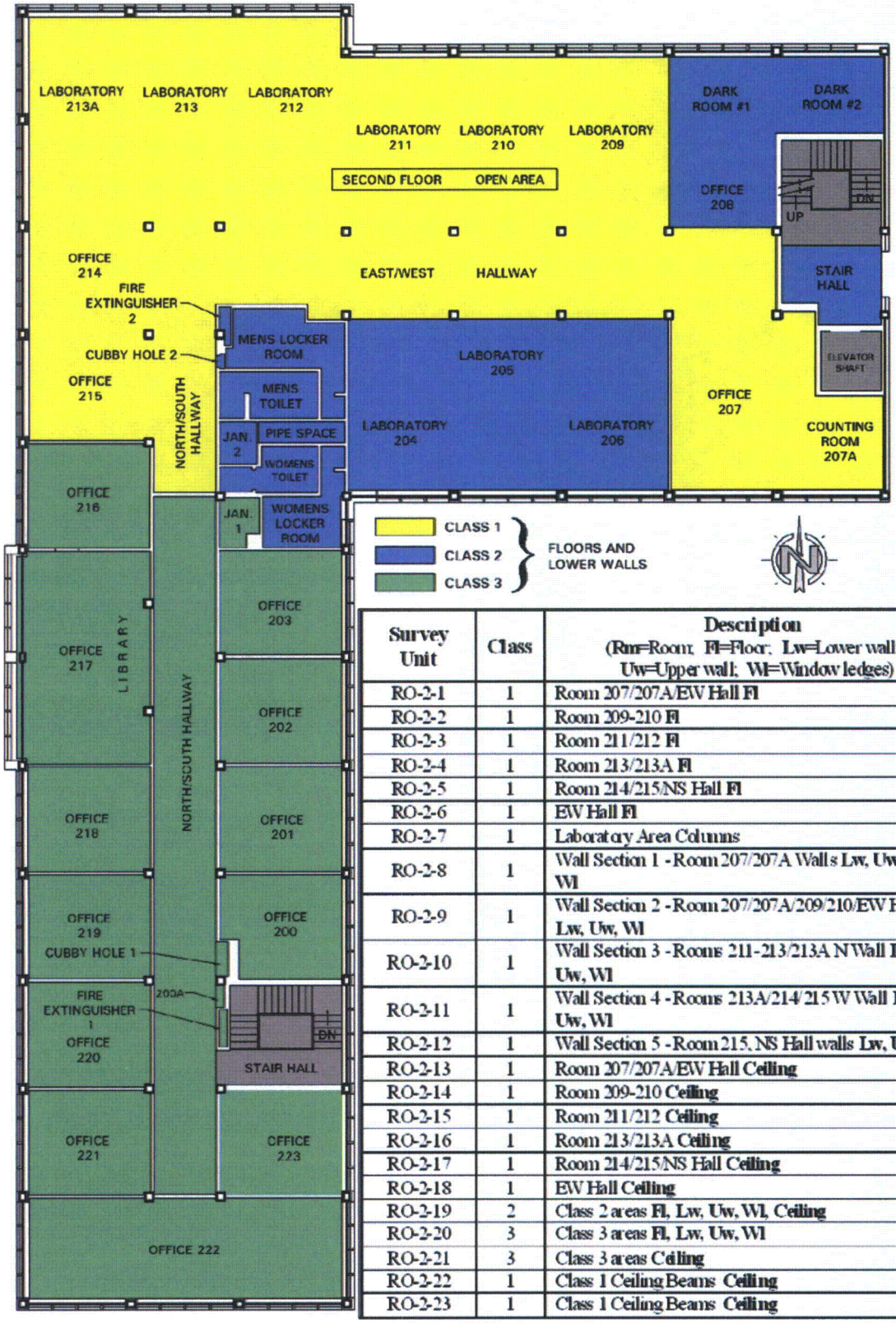
Exhibit 1, View of PBRF Showing ROLB and Reactor Building

Exhibit 2, Reactor Office and laboratory Building First Floor Survey Units



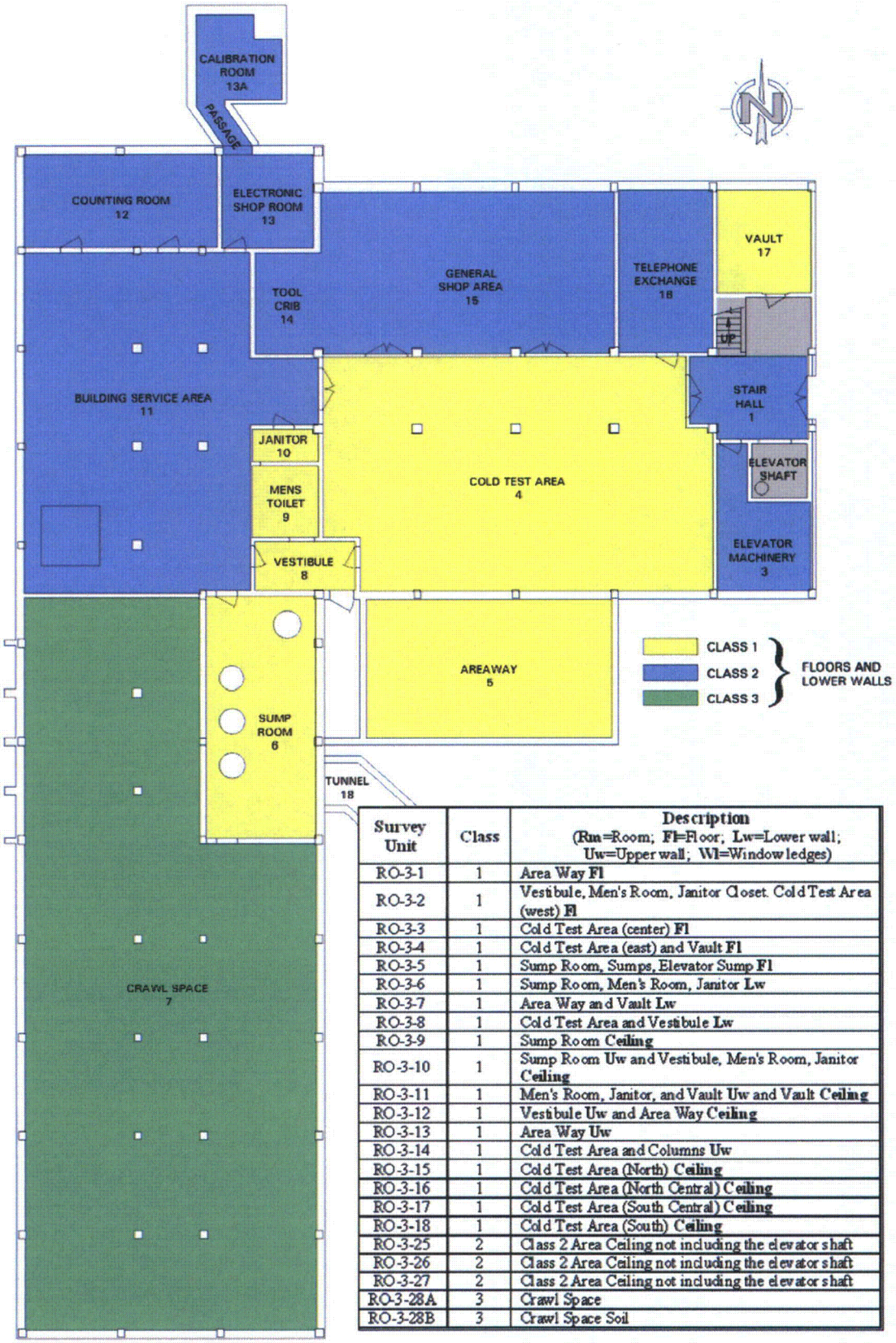
Survey Unit	Class	Description (Rm=Room; Fl=Floor; Lw=Lower wall; Uw=Upper wall; Wl=Window ledges)
RO-1-1	1	Rm 117/118 – Fl
RO-1-2	1	Rm 117/118 – Lw, Wl
RO-1-3	1	Rms119/120 – Fl
RO-1-4	1	Rm 119/120 – Lw, Wl
RO-1-5	2	Rm 109 - 111 Fl, Lw, Wl, Rm112 - 116 Fl, Lw, Uw, Wl. Rm117-120 Uw
RO-1-6	2	Rm 121 – 126 Fl, Lw, Wl, Restrooms, Closets, Phone Booth Fl, Lw, Uw
RO-1-7	2	N.E. Stairwell Fl, Lw, Uw, Ceiling S.E. Stairwell Fl, Lw, Uw, Ceiling
RO-1-8	2	East/West Hallway Fl, Lw, Uw
RO-1-9	2	Rm 112-120, restrooms, closet, pipe chase, E.-W. Hallway Ceiling
RO-1-10	3	North/South Hallway Fl, Lw, Uw
RO-1-11	3	Lobby, Rm100-108 Fl, Lw, Uw, Wl, Rm109-111, Rm 121-126 Uw
RO-1-12	3	Lobby, Rm100-111, Rm 121-126, North/South Hallway Ceiling

Exhibit 3, Reactor Office and Laboratory Building Second Floor Survey Units



Survey Unit	Class	Description (Rm=Room; Fl=Floor; Lw=Lower wall; Uw=Upper wall; Wl=Window ledges)
RO-2-1	1	Room 207/207A/EW Hall Fl
RO-2-2	1	Room 209-210 Fl
RO-2-3	1	Room 211/212 Fl
RO-2-4	1	Room 213/213A Fl
RO-2-5	1	Room 214/215/NS Hall Fl
RO-2-6	1	EW Hall Fl
RO-2-7	1	Laboratory Area Columns
RO-2-8	1	Wall Section 1 - Room 207/207A Walls Lw, Uw, Wl
RO-2-9	1	Wall Section 2 - Room 207/207A/209/210/EW Hall Lw, Uw, Wl
RO-2-10	1	Wall Section 3 - Rooms 211-213/213A N Wall Lw, Uw, Wl
RO-2-11	1	Wall Section 4 - Rooms 213A/214/215 W Wall Lw, Uw, Wl
RO-2-12	1	Wall Section 5 - Room 215, NS Hall walls Lw, Uw
RO-2-13	1	Room 207/207A/EW Hall Ceiling
RO-2-14	1	Room 209-210 Ceiling
RO-2-15	1	Room 211/212 Ceiling
RO-2-16	1	Room 213/213A Ceiling
RO-2-17	1	Room 214/215/NS Hall Ceiling
RO-2-18	1	EW Hall Ceiling
RO-2-19	2	Class 2 areas Fl, Lw, Uw, Wl, Ceiling
RO-2-20	3	Class 3 areas Fl, Lw, Uw, Wl
RO-2-21	3	Class 3 areas Ceiling
RO-2-22	1	Class 1 Ceiling Beams Ceiling
RO-2-23	1	Class 1 Ceiling Beams Ceiling

Exhibit 4, Reactor Office and Laboratory Building Basement Survey Units



Survey Unit	Class	Description (Rm=Room; Fl=Floor; Lw=Lower wall; Uw=Upper wall; Wl=Window ledges)
RO-3-1	1	Area Way **Fl**
RO-3-2	1	Vestibule, Men's Room, Janitor Closet. Cold Test Area (west) **Fl**
RO-3-3	1	Cold Test Area (center) **Fl**
RO-3-4	1	Cold Test Area (east) and Vault **Fl**
RO-3-5	1	Sump Room, Sumps, Elevator Sump **Fl**
RO-3-6	1	Sump Room, Men's Room, Janitor **Lw**
RO-3-7	1	Area Way and Vault **Lw**
RO-3-8	1	Cold Test Area and Vestibule **Lw**
RO-3-9	1	Sump Room **Ceiling**
RO-3-10	1	Sump Room **Uw** and Vestibule, Men's Room, Janitor **Ceiling**
RO-3-11	1	Men's Room, Janitor, and Vault **Uw** and Vault **Ceiling**
RO-3-12	1	Vestibule **Uw** and Area Way **Ceiling**
RO-3-13	1	Area Way **Uw**
RO-3-14	1	Cold Test Area and Columns **Uw**
RO-3-15	1	Cold Test Area (North) **Ceiling**
RO-3-16	1	Cold Test Area (North Central) **Ceiling**
RO-3-17	1	Cold Test Area (South Central) **Ceiling**
RO-3-18	1	Cold Test Area (South) **Ceiling**
RO-3-25	2	Class 2 Area Ceiling not including the elevator shaft
RO-3-26	2	Class 2 Area Ceiling not including the elevator shaft
RO-3-27	2	Class 2 Area Ceiling not including the elevator shaft
RO-3-28A	3	Crawl Space
RO-3-28B	3	Crawl Space Soil

Exhibit 5, Room 117-118 Electronics Lab (SU RO-1-1, Class 1)

Exhibit 6, Room 116 Floor and Lower Wall Showing Penetrations (RO-1-5, Class 2)

Exhibit 7, Room 109 Floor and Lower Wall (RO-1-11, Class 3)

Exhibit 8, Room 209-210 Laboratory Floor Showing Remediated Area & Penetration (R0-2-2, Class 1)

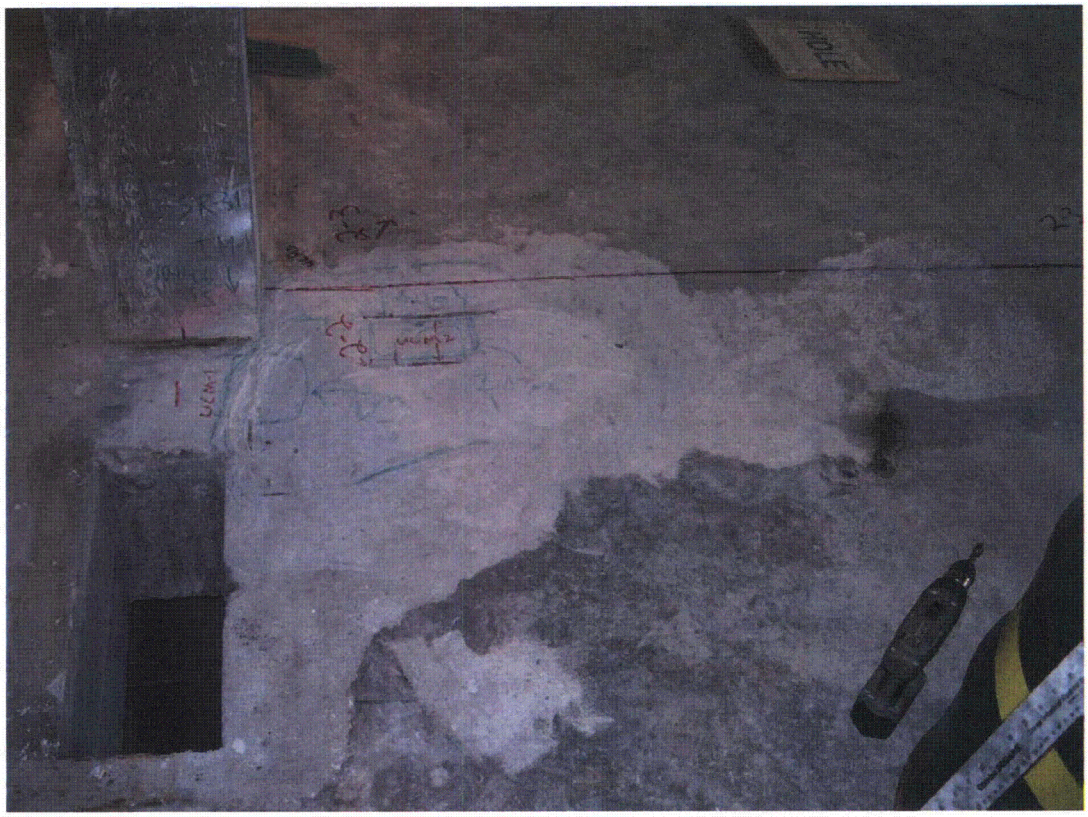


Exhibit 9, Rooms 213A-215, Laboratory Area (RO-2-11, Class 1)

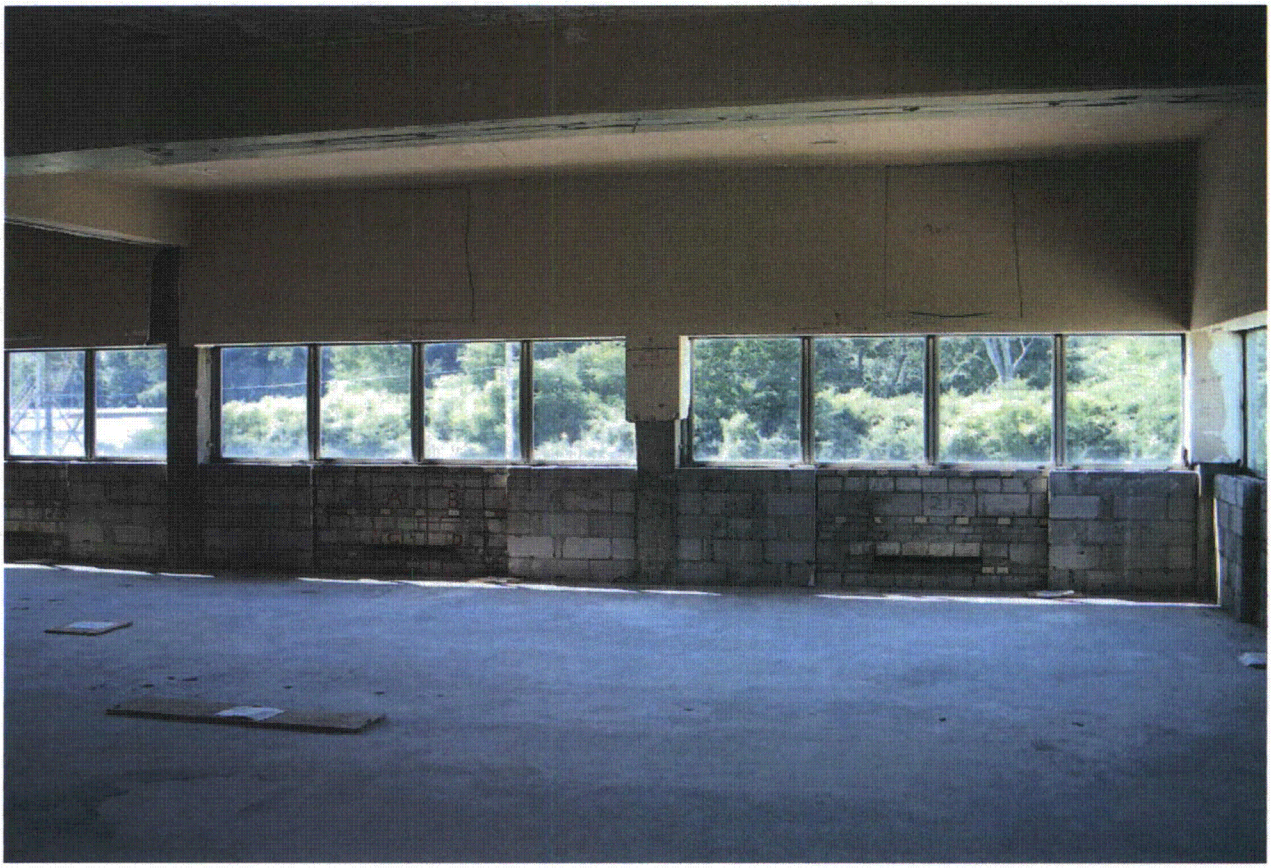


Exhibit 10, Sump Room North Wall Showing Penetrations (RO-3-10, Class 1)

Exhibit 11, New Fuel Vault Floor and Lower Walls (RO-3-4, Class 1)

Exhibit 12, Basement Men's Room Showing Extensive Remediation (RO-3-6, Class 1)

Exhibit 13, Basement Crawl Space Showing Poured Concrete Ceiling (RO-328A, Class3)

Exhibit 14, Room 213A West Wall Showing Example of a Surface Measurement Test Area (SMTA)

Exhibit 15, Sump Room Showing Example of Unusual Condition Measurement (UCM) Area

Plum Brook Reactor Facility

Final Status Survey Report

Attachment 1

Reactor Office and Laboratory Building (Building 1141)

Revision 0

Appendix B

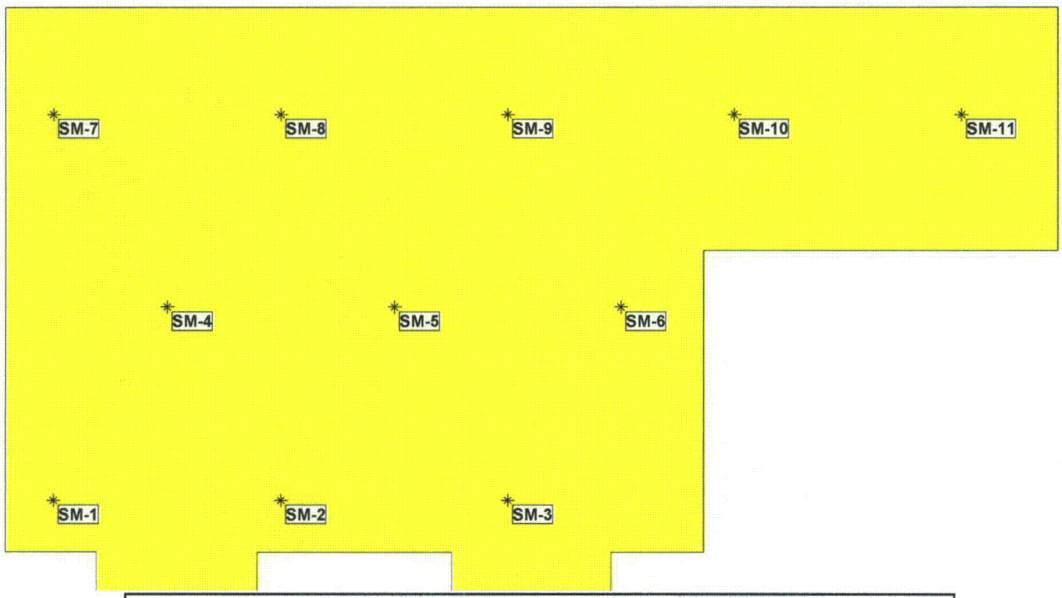
Survey Unit Maps and Tables Showing Measurement Locations and Results

Index of ROLB Survey Unit Maps and Tables of Coordinates

Index of ROLB Survey Unit Maps and Tables of Coordinates

Survey Unit RO-1-1

ROLB 1st Floor, Rooms 117 & 118 (Floor)



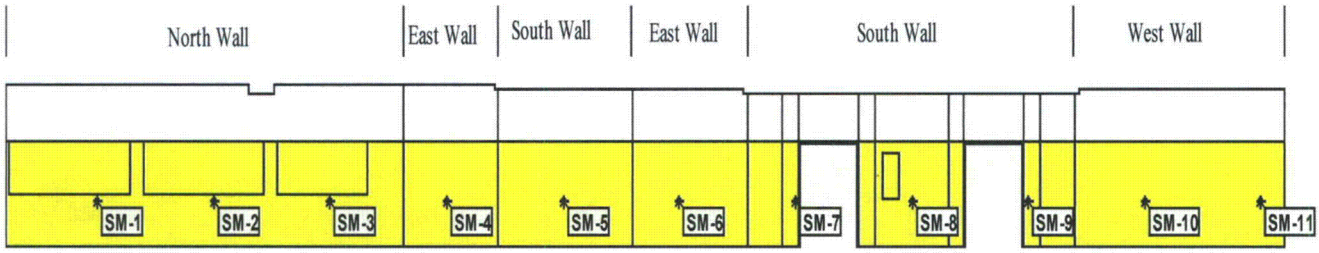
Survey Unit RO-1-1: ROLB Rooms 117 & 118 Floor					
X Coord	Y Coord	Label	Value	Type	Notes
0.6	0.6	SM-1	575	Systematic	NA
3.3	0.6	SM-2	535	Systematic	NA
6.0	0.6	SM-3	827	Systematic	NA
1.9	3.0	SM-4	685	Systematic	NA
4.7	3.0	SM-5	567	Systematic	NA
7.4	3.0	SM-6	496	Systematic	NA
0.6	5.4	SM-7	543	Systematic	NA
3.3	5.4	SM-8	535	Systematic	NA
6.0	5.4	SM-9	630	Systematic	NA
8.8	5.4	SM-10	512	Systematic	NA
11.5	5.4	SM-11	913	Systematic	NA

Table Notes:

1. Measurement locations are established on a triangular grid with randomly selected starting coordinates.
2. Measurement values are in units of dpm/100-cm^2.

Survey Unit RO-1-2

ROLB 1st Floor, Rooms 117 & 118 (Lower Walls)



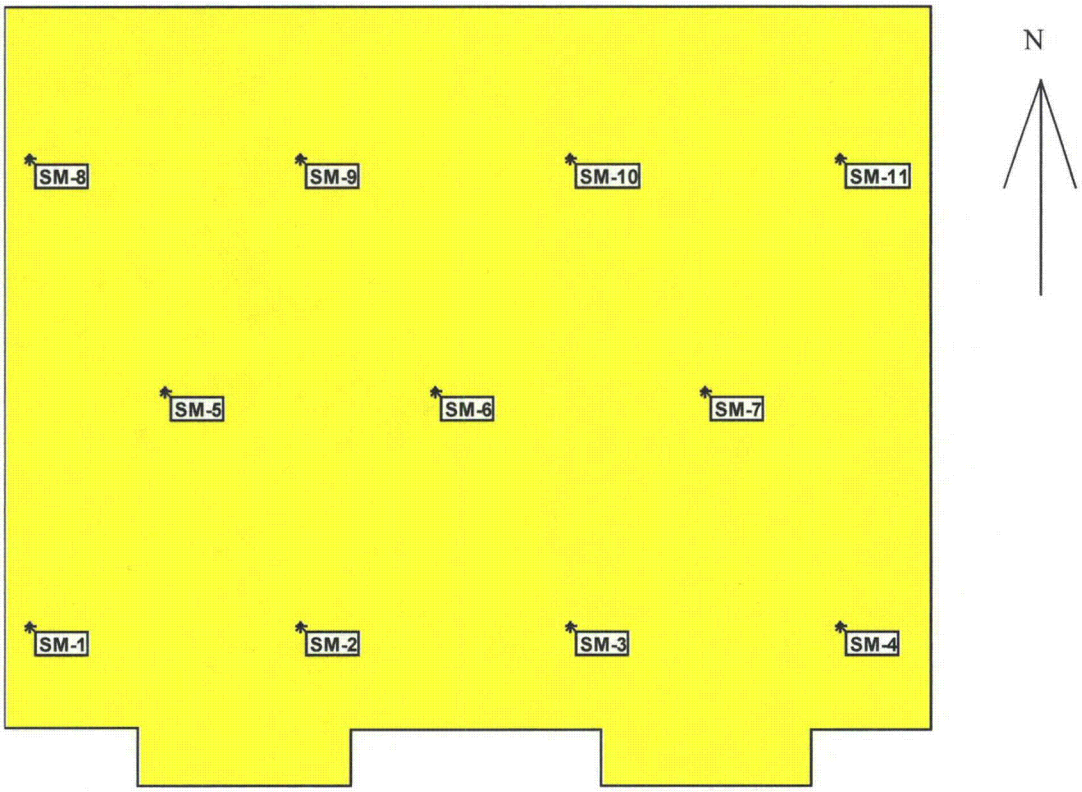
Survey Unit RO-1-2: ROLB Rooms 117 & 118, Lower Walls					
X Coord	Y Coord	Label	Value	Type	Notes
2.9	0.9	SM-1	-94	Systematic	NA
6.6	0.9	SM-2	55	Systematic	NA
10.4	0.9	SM-3	71	Systematic	NA
14.1	0.9	SM-4	354	Systematic	NA
17.8	0.9	SM-5	16	Systematic	NA
21.5	0.9	SM-6	260	Systematic	NA
25.2	0.9	SM-7	134	Systematic	NA
28.9	0.9	SM-8	-31	Systematic	NA
32.6	0.9	SM-9	-323	Systematic	NA
36.3	0.9	SM-10	189	Systematic	NA
40.0	0.9	SM-11	79	Systematic	NA

Table Notes:

1. Measurement locations are established on a triangular grid with randomly selected starting coordinates.
2. Measurement values are in units of dpm/100-cm^2.

Survey Unit RO-1-3

ROLB 1st Floor, Rooms 119 & 120 (Floor)



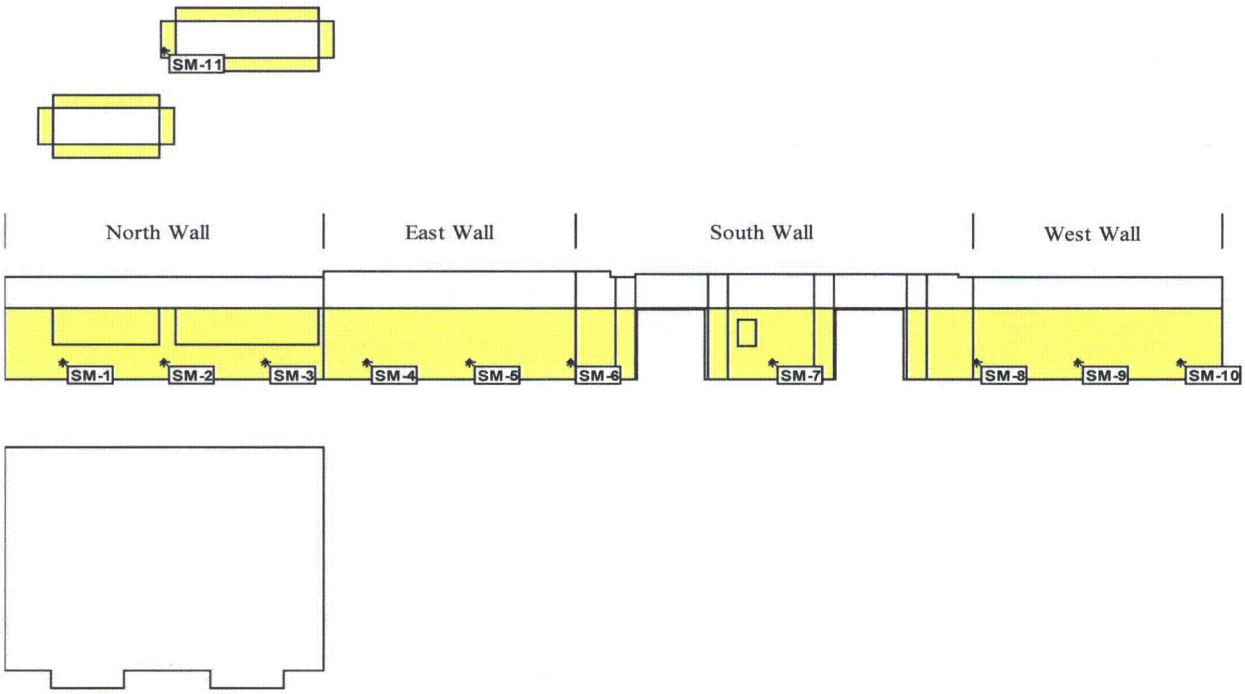
Survey Unit RO-1-3: ROLB 1st Floor, Rooms 119 & 120 (Floor)					
X Coord	Y Coord	Label	Value	Type	Notes
0.3	0.9	SM-1	638	Systematic	NA
2.8	0.9	SM-2	795	Systematic	NA
5.3	0.9	SM-3	890	Systematic	NA
7.7	0.9	SM-4	669	Systematic	NA
1.5	3.1	SM-5	693	Systematic	NA
4.0	3.1	SM-6	646	Systematic	NA
6.5	3.1	SM-7	787	Systematic	NA
0.3	5.3	SM-8	717	Systematic	NA
2.8	5.3	SM-9	591	Systematic	NA
5.3	5.3	SM-10	638	Systematic	NA
7.7	5.3	SM-11	-94	Systematic	NA

Table Notes:

1. Measurement locations are established on a triangular grid with randomly selected starting coordinates.
2. Measurement values are in units of dpm/100-cm^2.

Survey Unit RO-1-4

ROLB 1st Floor, Rooms 119 & 120 Lower Walls & Window Ledges



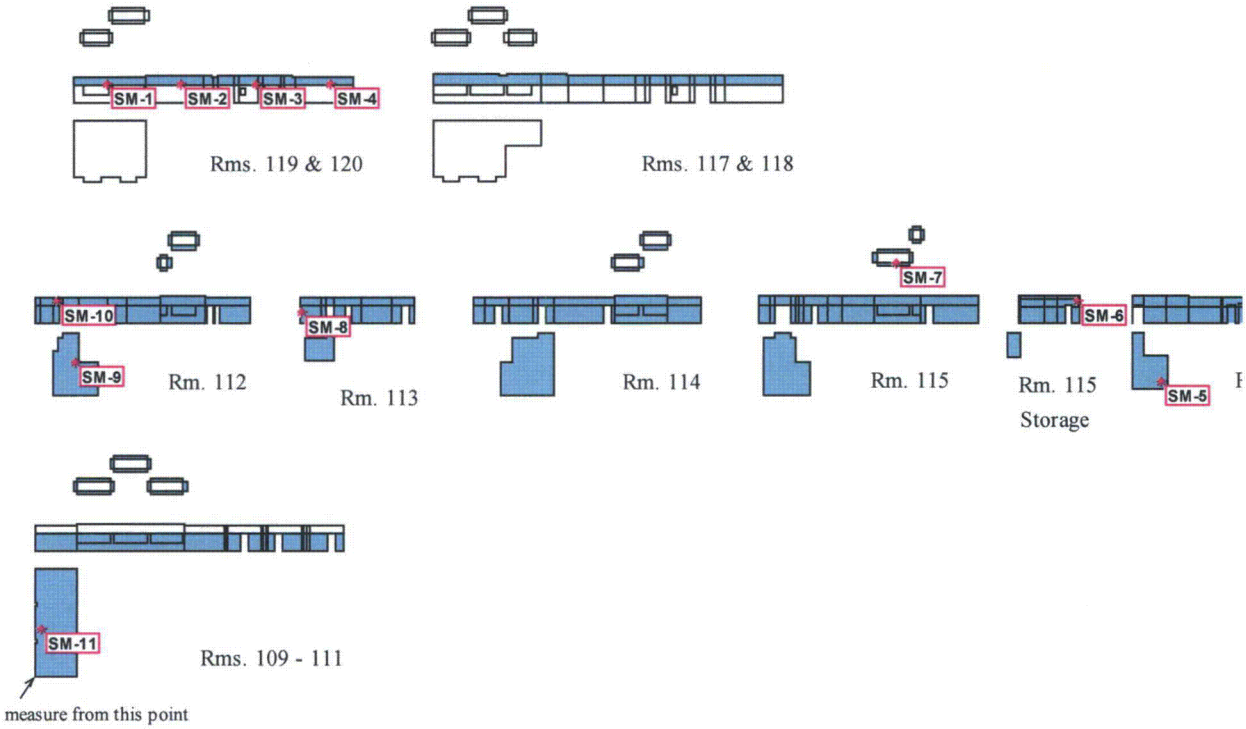
Survey Unit RO-1-4: ROLB Rooms 119 & 120 (lower walls and window ledges), Class 2					
X Co-ord (m)	**Y Co-ord (m)**	**Label**	**Type**	**Value**	**Notes**
1.54	0.53	SM-1	Systematic	157	NA
4.26	0.53	SM-2	Systematic	528	NA
6.98	0.53	SM-3	Systematic	409	NA
1.17	0.53	SM-4	Systematic	260	NA
3.88	0.53	SM-5	Systematic	118	NA
6.60	0.53	SM-6	Systematic	0	NA
1.24	0.53	SM-7	Systematic	0	NA
0.10	0.53	SM-8	Systematic	0	NA
2.82	0.53	SM-9	Systematic	31	NA
5.54	0.53	SM-10	Systematic	94	NA
-0.32	0.21	SM-11	Systematic	0	On west side of east window

Table Notes:

1. Measurement locations are established on a triangular grid with randomly selected starting coordinates.
2. Measurement values are in units of dpm/100-cm^2.
3. With the exception of SM-11, all of the other sample measurements are located by taking the lowest left-hand corner, of the surface on which they rest, as the origin. For example, the location of SM-1 is measured from the lower left hand corner of the north wall. SM-11 uses the glass and the lower ledge as the origin so one measures from the glass 0.32 meters out and then up 0.21 meters.

Survey Unit RO-1-5

ROLB 1st Floor Class 2, Survey Unit, Rooms 109-120



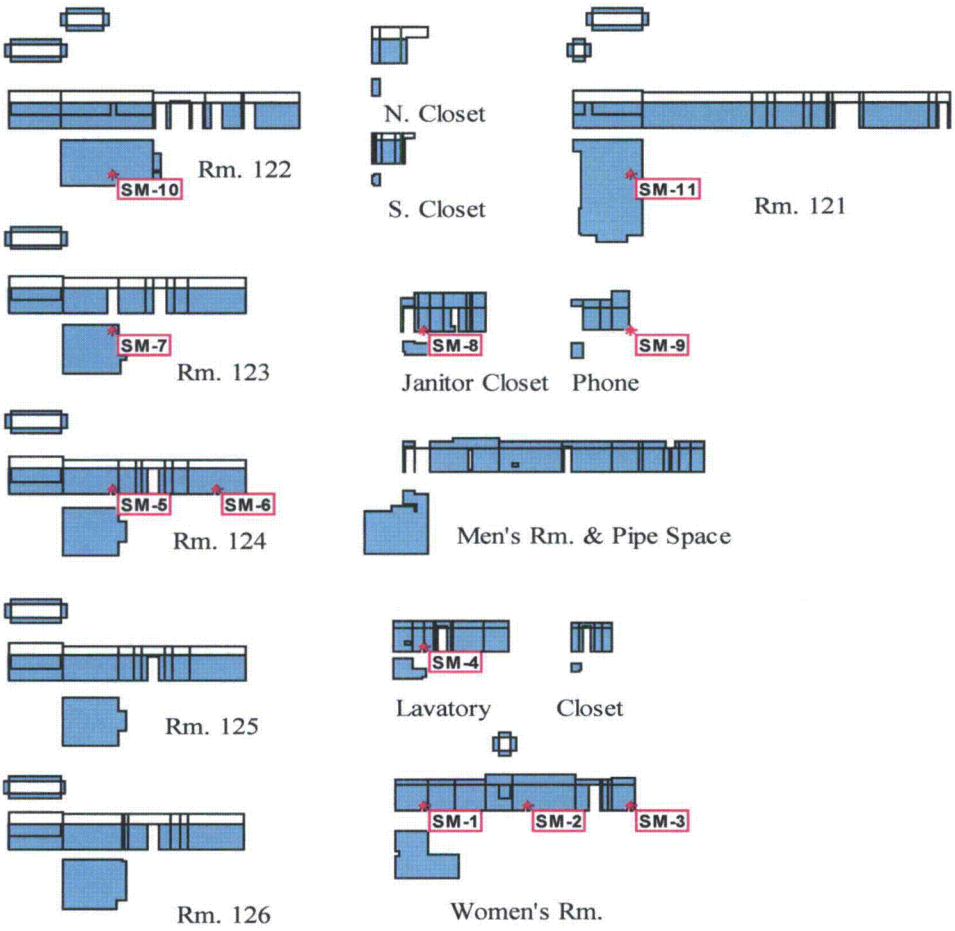
Survey Unit RO-1-5: ROLB 1st Floor, Rooms 109-120					
X Co-ord (m)	Y Co-ord (m)	Label	Value	Type	Notes
3.92	2.34	SM-1	173	Systematic	N/A
3.98	2.34	SM-2	94	Systematic	N/A
1.80	2.34	SM-3	220	Systematic	N/A
3.85	2.34	SM-4	-87	Systematic	N/A
3.25	0.84	SM-5	693	Systematic	N/A
2.33	2.76	SM-6	39	Systematic	N/A
2.16	-0.02	SM-7	-71	Systematic	Window sill
0.05	1.30	SM-8	102	Systematic	N/A
2.54	3.83	SM-9	543	Systematic	N/A
0.28	2.75	SM-10	94	Systematic	N/A
0.68	5.57	SM-11	677	Systematic	N/A

Table Notes:

1. Measurement locations are established on a triangular grid with randomly selected starting coordinates.
2. Measurement values are in units of dpm/100-cm^2.
3. Other than SM-7, all of the other sample measurements are located by taking the lowest left-hand corner of the surface on which they rest as the origin. For example, the location of SM-1 is measured from the lower left corner of the wall with windows. SM-7 (window sill), on the other hand, is measured from the inside left corner closest to the glass.

Survey Unit RO-1-6

ROLB 1st Floor Class 2 Survey Unit, Rooms 121-126

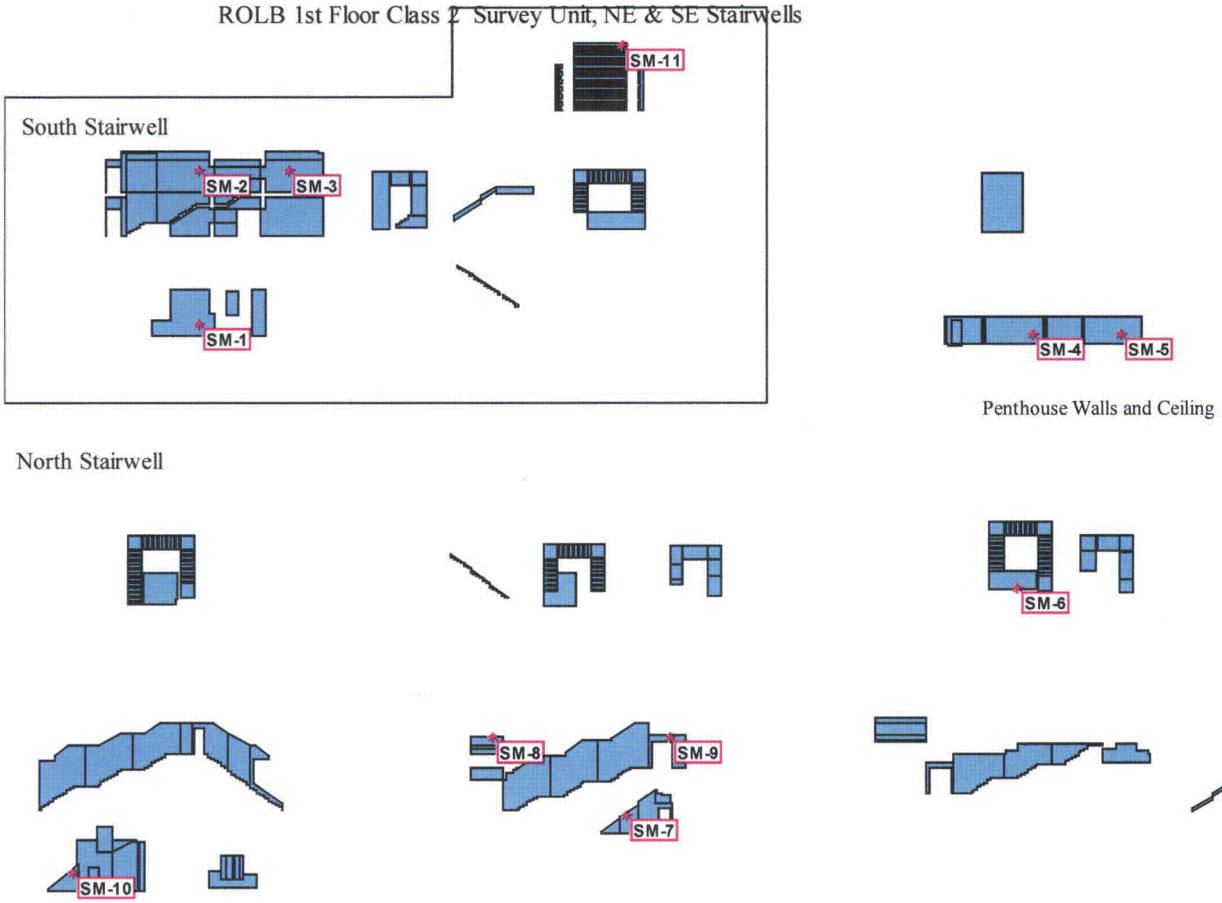


Survey Unit RO-1-6: ROLB 1st Floor, Rooms 121-126					
X Co-ord (m)	Y Co-ord (m)	Label	Value	Type	Notes
1.96	0.42	SM-1	2000	Systematic	N/A
0.98	0.42	SM-2	1830	Systematic	N/A
1.35	0.42	SM-3	2170	Systematic	N/A
0.66	0.30	SM-4	2500	Systematic	N/A
3.58	0.49	SM-5	315	Systematic	N/A
1.94	0.49	SM-6	55	Systematic	N/A
3.59	3.68	SM-7	811	Systematic	N/A
0.32	0.14	SM-8	268	Systematic	N/A
1.22	0.02	SM-9	559	Systematic	N/A
3.76	1.05	SM-10	835	Systematic	N/A
-1.03	-2.84	SM-11	417	Systematic	Measured from NE corner of room

Table Notes:

1. Measurement locations are established on a triangular grid with randomly selected starting coordinates.
2. Measurement values are in units of dpm/100-cm^2.
3. Other than SM-11, all of the other sample measurements are located by taking the lowest left-hand corner, of the surface on which they rest, as the origin. For example, the location of SM-1 is measured from the lower left hand corner of the wall. SM-11, on the other hand, is measured from the northeast corner of the room.

Survey Unit RO-1-7

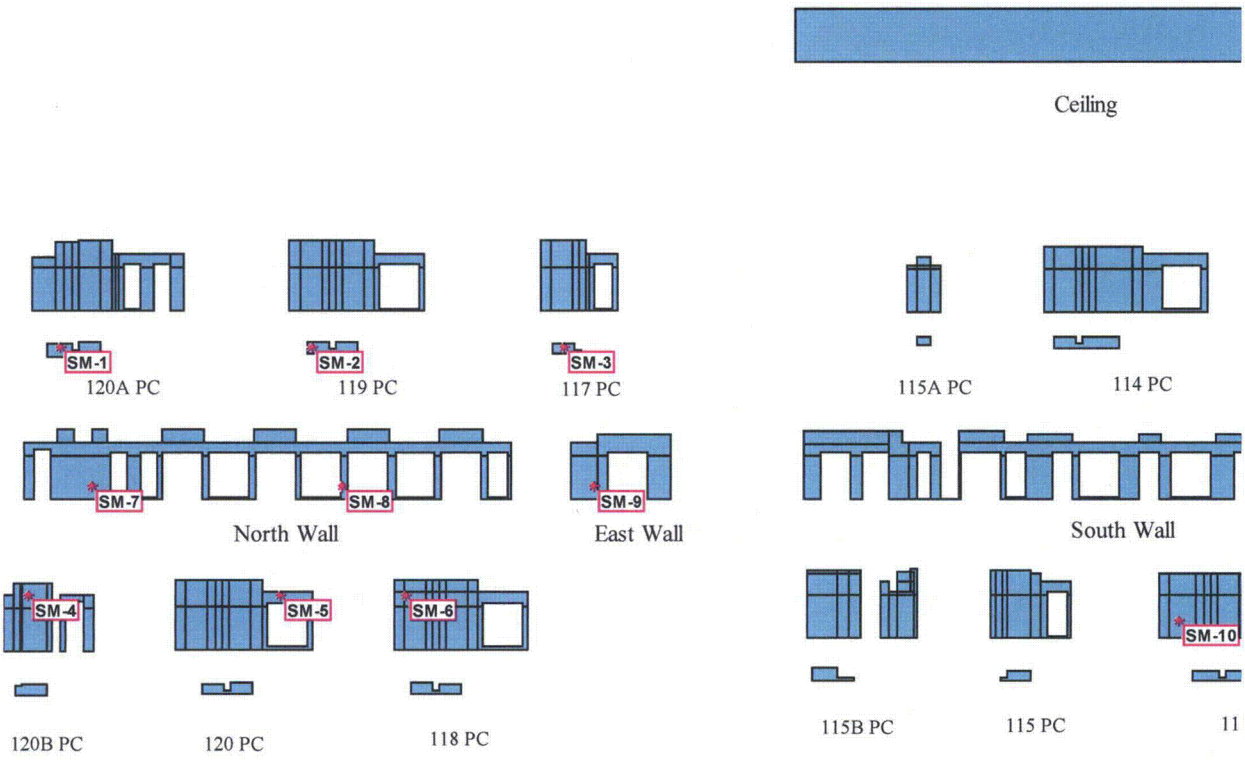


Survey Unit RO-1-7: ROLB North and South Stairwells					
X Co-ord (m)	Y Co-ord (m)	Label	Value	Type	Notes
0.85	1.55	SM-1	-30	Systematic	Under stairs
1.75	1.10	SM-2	79	Systematic	North wall
1.65	1.09	SM-3	122	Systematic	South wall
3.78	.60	SM-4	720	Systematic	2nd floor landing
1.52	1.86	SM-5	-37	Systematic	West wall
0.54	0.67	SM-6	262	Systematic	Under stairs
0.44	1.88	SM-7	55	Systematic	West wall
0.70	0.11	SM-8	140	Systematic	Vertical surface between 6th step and landing
0.31	2.27	SM-9	37	Systematic	East wall
-0.21	2.10	SM-10	262	Systematic	West wall
0.71	0.11	SM-11	1159	Systematic	3rd step

Table Notes:

1. Measurement locations are established on a triangular grid with randomly selected starting coordinates.
2. Measurement values are in units of dpm/100-cm^2.
3. Other than SM-10, all of the other sample measurements are located by taking the lowest left-hand corner, of the surface on which they rest, as the origin. For example, the location of SM-5 is measured from the lower left hand corner of the west wall. SM-10 is measured from the lower east corner where the top of the bottom stair step meets the west wall.

Survey Unit RO-1-8
ROLB 1st Floor Class 2 Survey Unit, EW Hallway



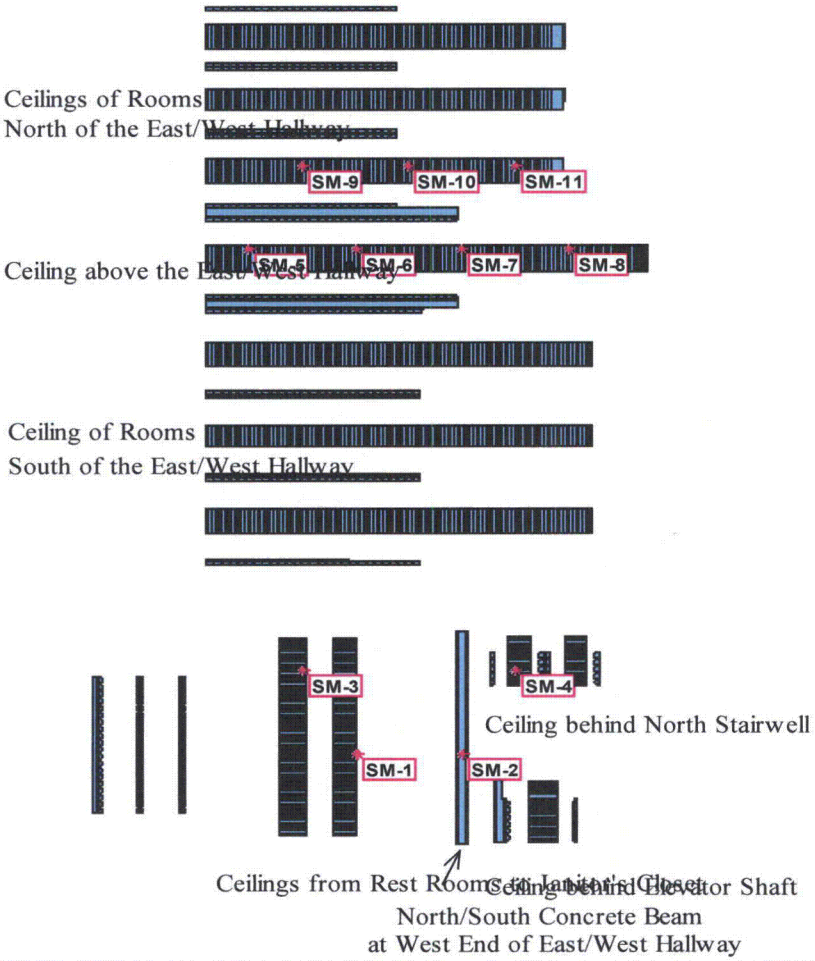
Survey Unit RO-1-8: ROLB East/West Hallway					
X Co-ord (m)	Y Co-ord (m)	Label	Value	Type	Notes
0.56	0.41	SM-1	710	Systematic	N/A
0.12	0.25	SM-2	1000	Systematic	N/A
0.45	0.30	SM-3	637	Systematic	N/A
0.21	2.53	SM-4	532	Systematic	Rear wall of pipe chase
0.74	2.53	SM-5	435	Systematic	Inside of front wall
0.48	2.53	SM-6	476	Systematic	Far left wall
1.77	0.59	SM-7	-129	Systematic	N/A
-0.31	0.59	SM-8	234	Systematic	N/A
1.01	0.58	SM-9	-24	Systematic	N/A
0.36	0.87	SM-10	347	Systematic	Back wall left of column
-0.08	0.87	SM-11	403	Systematic	Inside front wall

Table Notes:

1. Measurement locations are established on a triangular grid with randomly selected starting coordinates.
2. Measurement values are in units of dpm/100-cm^2.
3. Other than SM-8 and SM-11, all of the other sample measurements are located by taking the lowest left-hand corner, of the surface on which they rest, as the origin. For example, the location of SM-7 is measured from the lower left hand corner of the north wall. Both SM-8 and SM-11 are measured from the lower right corner where the walls meet the floor.

Survey Unit RO-1-9

ROLB 1st Floor Class 2 Survey Unit, Rooms 112-120 & EW Hallway Ceilings

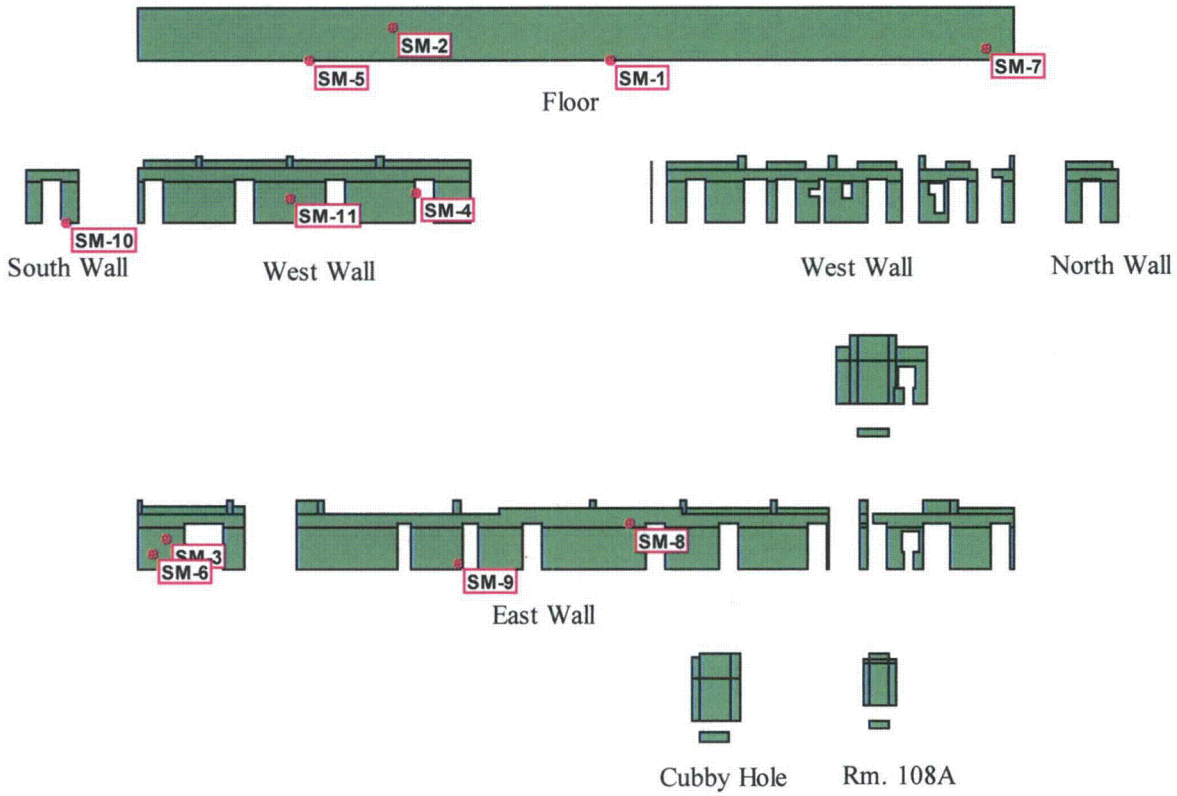


Survey Unit RO-1-9: ROLB 1st Floor, Class 2 Ceilings					
X Co-ord (m)	Y Co-ord (m)	Label	Value	Type	Notes
1.91	7.51	SM-1	1031	Systematic	Overhead of Men's Room
0.29	0.58	SM-2	268	Systematic	North of south column
1.83	15.2	SM-3	685	Systematic	Overhead of Men's Room
0.57	1.43	SM-4	630	Systematic	Overhead of Rm. 117
3.51	1.97	SM-5	622	Systematic	Overhead of east/west hallway
12.34	1.97	SM-6	724	Systematic	
21.17	1.97	SM-7	339	Systematic	
29.99	1.97	SM-8	480	Systematic	
7.93	1.48	SM-9	567	Systematic	Overhead of Rm. 119/120
16.76	1.48	SM-10	528	Systematic	Overhead of Rm. 117/118
25.58	1.48	SM-11	457	Systematic	Overhead of Rm. 117/118

Table Notes:

1. Measurement locations are established on a triangular grid with randomly selected starting coordinates.
2. Measurement values are in units of dpm/100-cm^2.
3. Other than SM-2, all of the other sample measurements are located by taking the lowest left-hand corner, of the surface on which they rest, as the origin. For example, the location of SM-4 is measured from the lower left hand corner (southwest corner) of the ceiling. SM-2, on the other hand, is measured from inside the south ceiling support column.

Survey Unit RO-1-10
ROLB 1st Floor Class 3 Survey Unit, N-S Hallway



Survey Unit RO-1-10: ROLB 1st Floor, N-S Hallway, Class 3					
X Co-ord (m)	Y Co-ord (m)	Label	Value	Type	Notes
22.17	0.04	SM-1	1960	Random	N/A
11.85	1.56	SM-2	730	Random	N/A
1.22	1.45	SM-3	241	Random	N/A
12.95	1.51	SM-4	220	Random	N/A
7.98	0.02	SM-5	433	Random	N/A
0.58	0.69	SM-6	57	Random	N/A
39.88	0.61	SM-7	411	Random	N/A
15.68	2.14	SM-8	57	Random	N/A
7.58	0.24	SM-9	135	Random	N/A
1.86	0.01	SM-10	220	Random	N/A
7.05	1.23	SM-11	206	Random	N/A

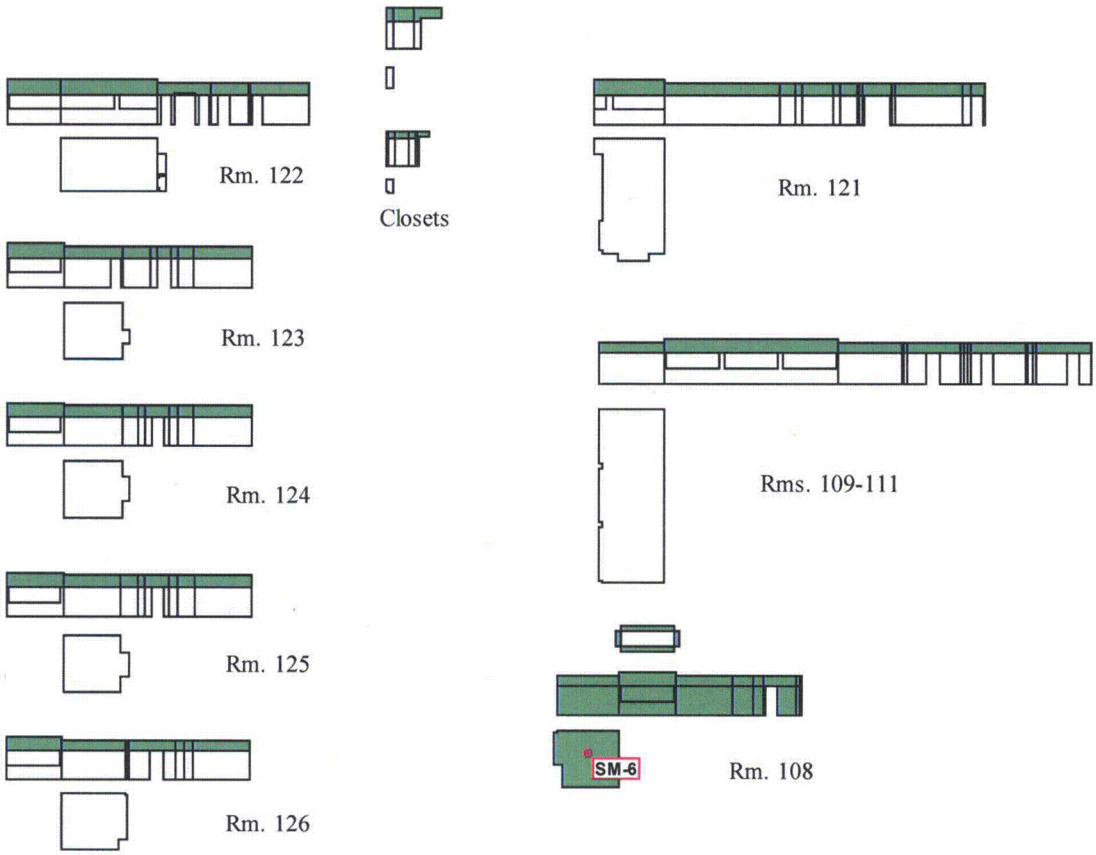
Table Notes:

1. Measurement locations are selected on a random basis – Class 3 survey unit.
2. Measurement values are in units of dpm/100-cm^2.
3. All sample measurements are located by taking the lowest left-hand corner, of the surface on which they rest, as the origin. For example, the location of SM-1 is measured from the lower left hand corner (southeast corner) of the north/south hallway.

Survey Unit RO-1-11

ROLB 1st Floor Class 3 Survey Unit, Lobby, Rooms 100-108, 109-111, 121-126

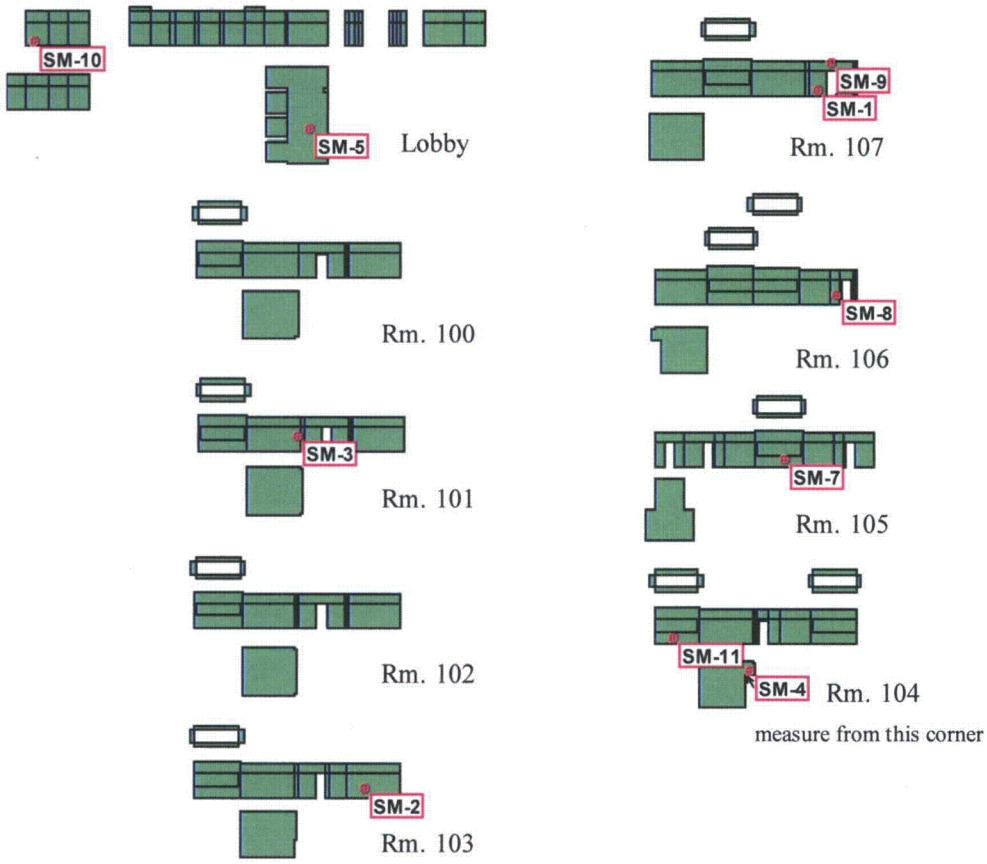
(page 1 of 2)



Survey Unit RO-1-11

ROLB 1st Floor Class 3 Survey Unit, Lobby, Rooms 100-108, 109-111, 121-126

(Page 2 of 2)



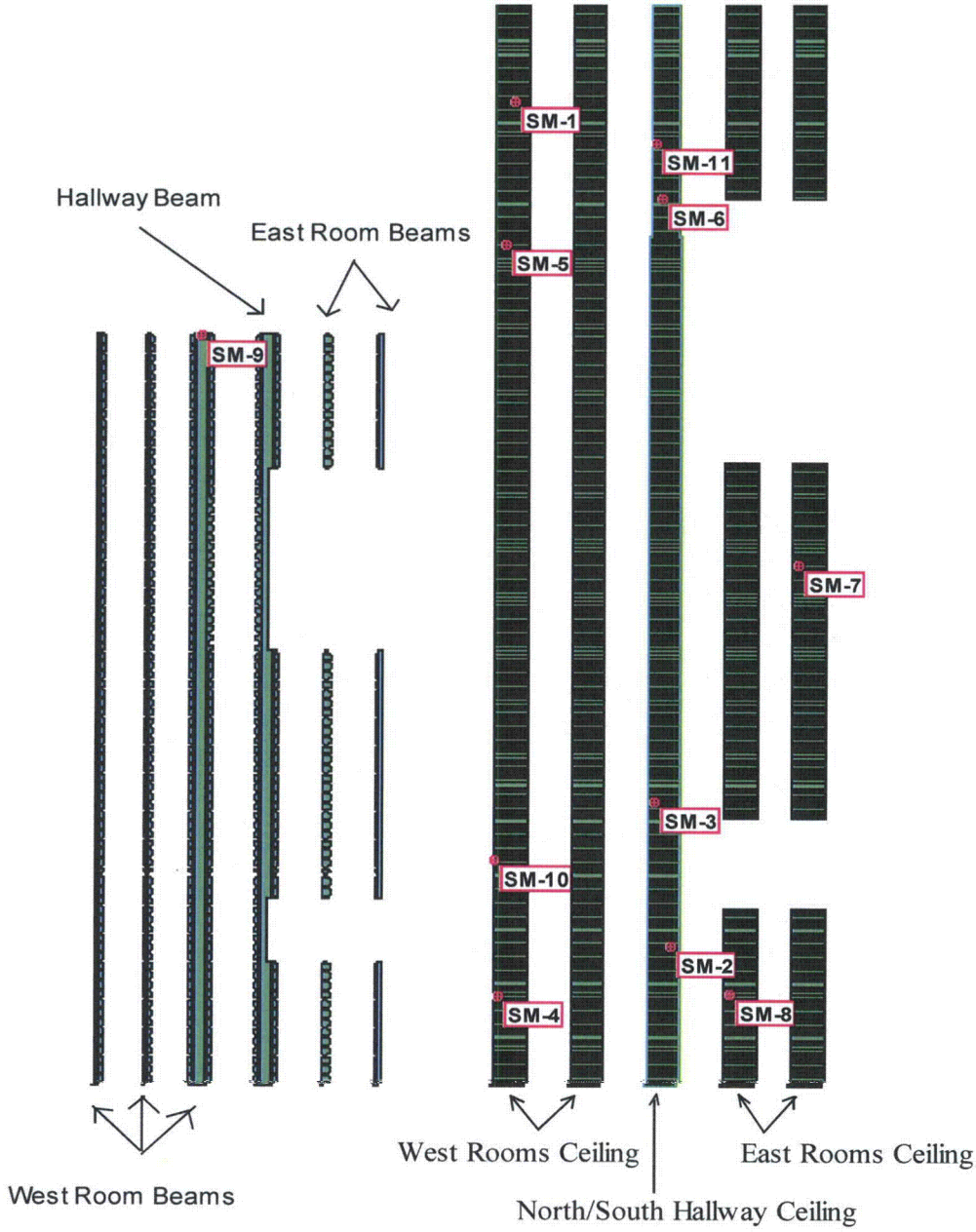
Survey Unit RO-1-11: ROLB 1st Floor, Class 3					
X Co-ord (m)	Y Co-ord (m)	Label	Value	Type	Notes
0.75	0.56	SM-1	231	Random	N/A
1.47	0.95	SM-2	340	Random	N/A
4.25	1.41	SM-3	-324	Random	N/A
0.27	0.30	SM-4	528	Random	See map for point of origin
3.68	2.87	SM-5	1306	Random	N/A
1.74	2.54	SM-6	463	Random	N/A
2.50	0.70	SM-7	204	Random	N/A
0.52	0.74	SM-8	287	Random	N/A
1.91	2.84	SM-9	-9	Random	N/A
0.62	0.35	SM-10	583	Random	N/A
1.65	0.64	SM-11	231	Random	N/A

Table Notes:

1. Measurement locations are selected on a random basis – Class 3 survey unit.
2. Measurement values are in units of dpm/100-cm^2.
3. With the exception of SM-4 all other sample measurements are located by taking the lowest left-hand corner, of the surface on which they rest, as the origin. For example, the location of SM-11 is measured from the lower left hand corner of the west wall of Room 104 (the extreme southwest corner of the room). SM-4 is measured from a point just inside the entrance door (see map for location).

Survey Unit RO-1-12
(Page 1 of 2)

ROLB 1st Floor Class 3 Survey Unit, Rooms 110-111, 121-126 & N-S Hallway



Survey Unit RO-1-12
(Page 2 of 2)

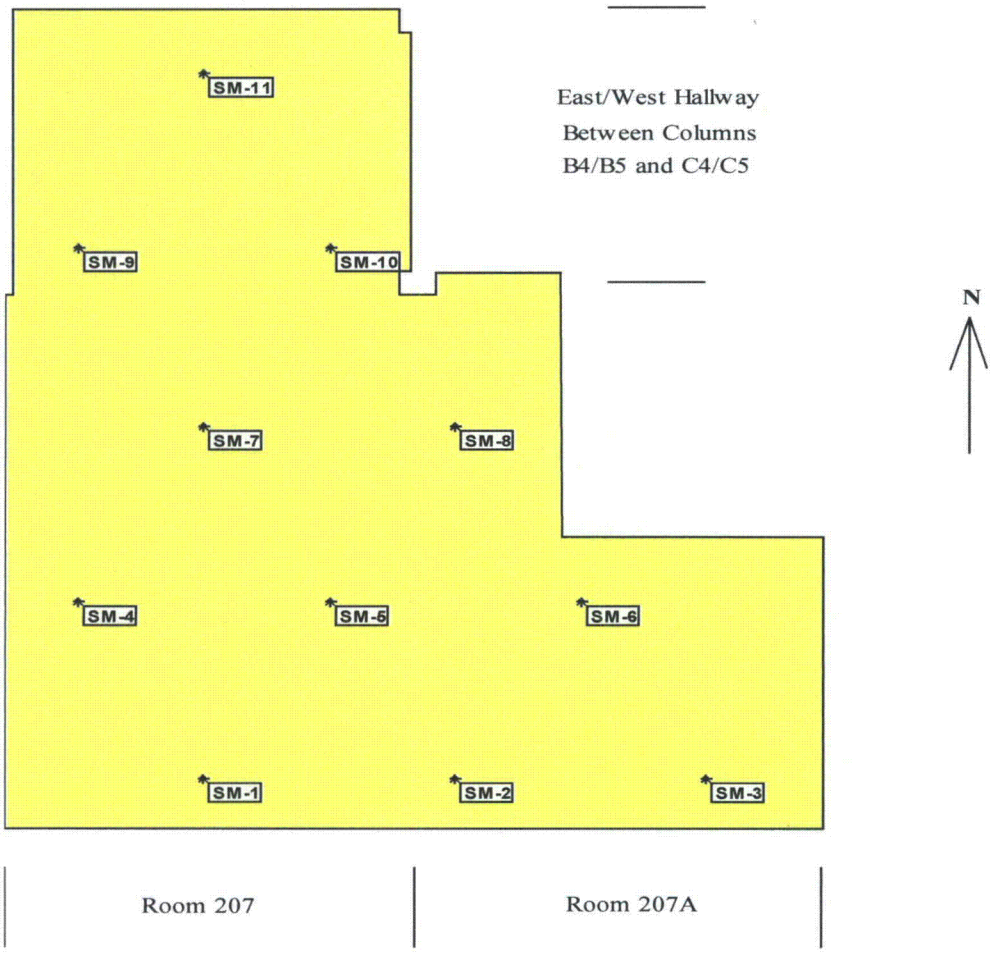
Survey Unit RO-1-12: ROLB 1st Floor Class 3					
X Co-ord (m)	Y Co-ord (m)	Label	Value	Type	Notes
1.25	N/A	SM-1	282	Random	Lowest horizontal surface of the 74th beam
1.62	N/A	SM-2	514	Random	North slanted surface of the 11th beam
0.41	N/A	SM-3	437	Random	Lowest horizontal surface of the 22nd beam
0.35	N/A	SM-4	479	Random	Between 7th and 8th beam
0.74	N/A	SM-5	289	Random	Between 63rd and 64th beam
0.90	N/A	SM-6	528	Random	South vertical surface of the 67th beam
0.46	N/A	SM-7	465	Random	Between 39th and 40th beam
0.45	N/A	SM-8	1000	Random	South vertical surface of the 8th beam
0.21	-0.16	SM-9	739	Random	Measured from the northwest corner
0.12	N/A	SM-10	585	Random	Between 17th and 18th beam
0.47	N/A	SM-11	359	Random	Lowest horizontal surface of the 71st beam

Table Notes:

1. Measurement locations are selected on a random basis – Class 3 survey unit.
2. Measurement values are in units of dpm/100-cm^2.
3. With the exception of SM-9, all other all other sample measurements are determined by taking the x-coordinate as the distance from the west wall. The notes column (above) denotes what beam the sample measurement point is located. SM-9 is measured from the extreme northwestern corner of the ceiling beam where it mates with the north wall above the double door opening.

Survey Unit RO-2-1

ROLB 2nd Floor Class 1 Survey Unit



*

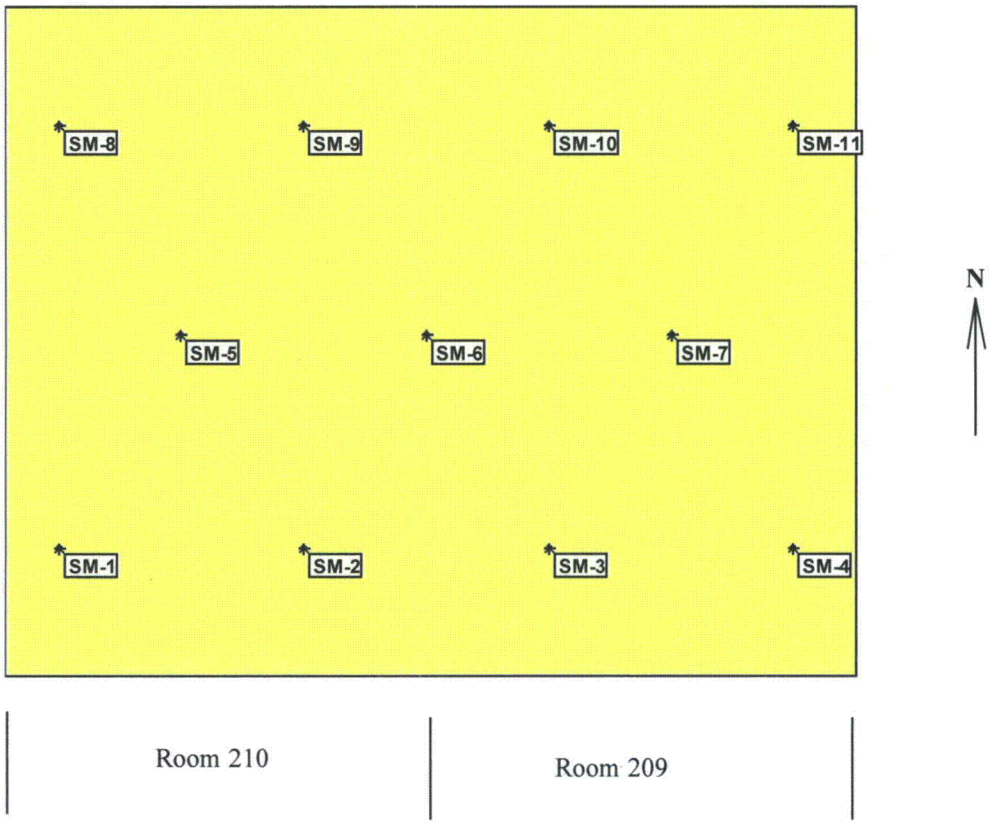
Survey Unit RO-2-1: ROLB 2nd Floor, Class 1					
X Co-ord (m)	Y Co-ord (m)	Label	Value	Type	Notes
2.05	0.63	SM-1	640	Systematic	N/A
4.63	0.63	SM-2	784	Systematic	N/A
7.21	0.63	SM-3	480	Systematic	N/A
0.75	2.86	SM-4	536	Systematic	N/A
3.34	2.86	SM-5	568	Systematic	N/A
5.92	2.86	SM-6	368	Systematic	N/A
2.05	5.10	SM-7	-8	Systematic	N/A
4.63	5.10	SM-8	216	Systematic	N/A
0.75	7.34	SM-9	480	Systematic	N/A
3.34	7.34	SM-10	160	Systematic	N/A
2.05	9.57	SM-11	296	Systematic	N/A

Table Notes:

1. Measurement locations are established on a triangular grid with randomly selected starting coordinates.
2. Measurement values are in units of dpm/100-cm^2.
3. All of the sample measurements are located by taking the lowest left-hand corner, of the surface on which they rest, as the origin. For example, the location of SM-1 is measured from the lower left hand corner of the survey unit (southwest corner of Room 207).

Survey Unit RO-2-2

ROLB 2nd Floor Class 1 Survey Unit

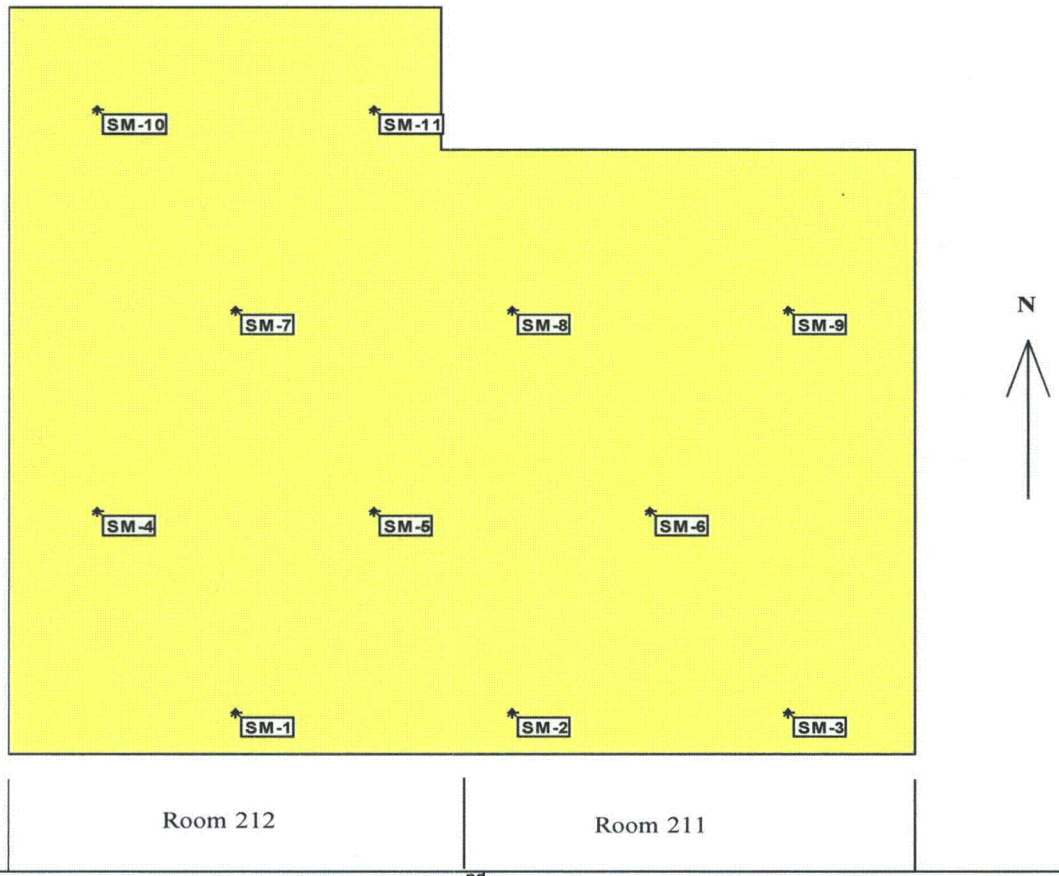


Survey Unit RO-2-2: ROLB 2nd Floor, Rooms 209-210 (floor), Class 1					
X Co-ord (m)	Y Co-ord (m)	Label	Value	Type	Notes
0.53	1.30	SM-1	887	Systematic	N/A
2.99	1.30	SM-2	742	Systematic	N/A
5.45	1.30	SM-3	421	Systematic	N/A
7.91	1.30	SM-4	767	Systematic	N/A
1.76	3.43	SM-5	779	Systematic	N/A
4.22	3.43	SM-6	761	Systematic	N/A
6.68	3.43	SM-7	1100	Systematic	N/A
0.53	5.56	SM-8	830	Systematic	N/A
2.99	5.56	SM-9	836	Systematic	N/A
5.45	5.56	SM-10	823	Systematic	N/A
7.91	5.56	SM-11	723	Systematic	N/A

Table Notes:

1. Measurement locations are established on a triangular grid with randomly selected starting coordinates.
2. Measurement values are in units of dpm/100-cm^2.
3. All of the sample measurements are located by taking the lowest left-hand corner, of the surface on which they rest, as the origin. For example, the location of SM-1 is measured from the lower left hand corner of the survey unit (at column E4).

Survey Unit RO 2-3
ROLB 2nd Floor Class 1 Survey Unit



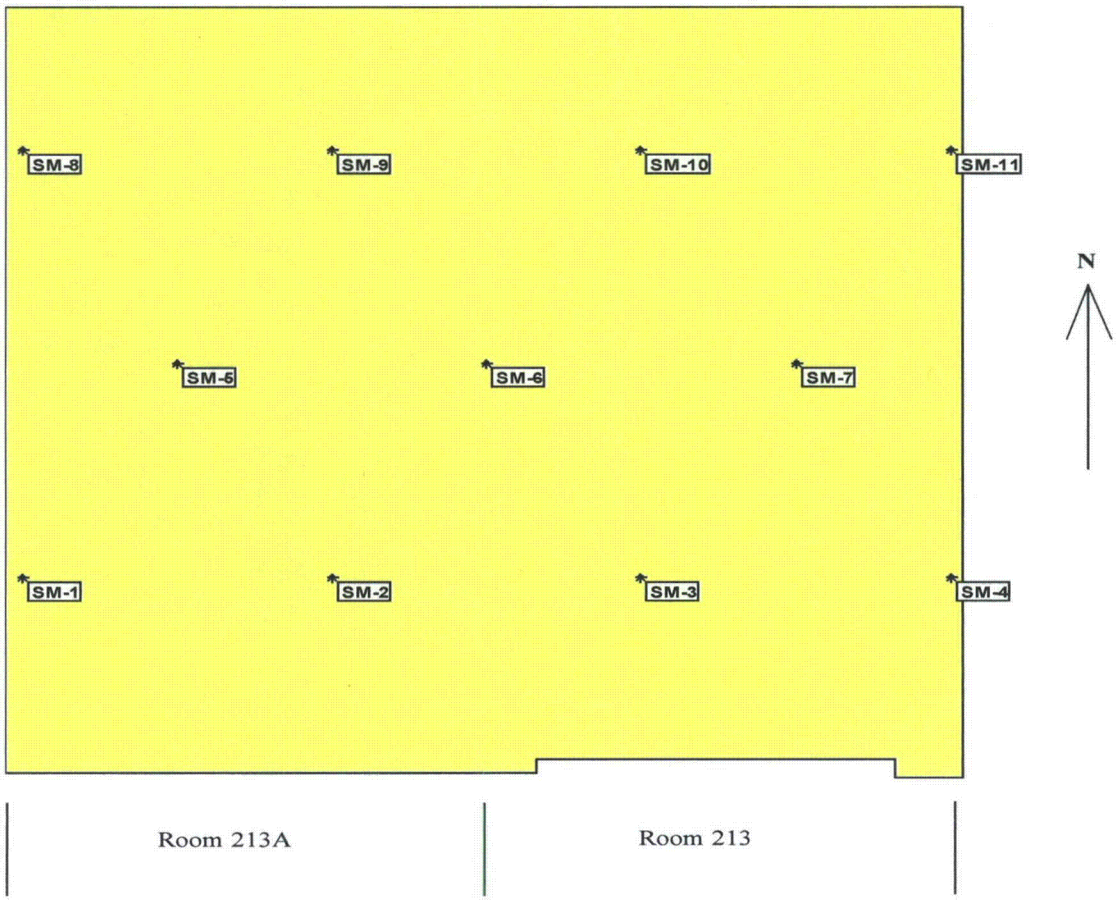
Survey Unit RO-2-3: ROLB 2nd Floor, Rooms 211-212 (floor) Class 1					
X Co-ord (m)	Y Co-ord (m)	Label	Value	Type	Notes
2.15	0.46	SM-1	832	Systematic	N/A
4.75	0.46	SM-2	700	Systematic	N/A
7.34	0.46	SM-3	627	Systematic	N/A
0.85	2.71	SM-4	788	Systematic	N/A
3.45	2.71	SM-5	459	Systematic	N/A
6.04	2.71	SM-6	1021	Systematic	N/A
2.15	4.96	SM-7	890	Systematic	N/A
4.75	4.96	SM-8	766	Systematic	N/A
7.34	4.96	SM-9	810	Systematic	N/A
0.85	7.21	SM-10	744	Systematic	N/A
3.45	7.21	SM-11	919	Systematic	N/A

Table Notes:

1. Measurement locations are established on a triangular grid with randomly selected starting coordinates.
2. Measurement values are in units of dpm/100-cm^2.
3. All of the sample measurements are located by taking the lowest left-hand corner, of the surface on which they rest, as the origin. For example, the location of SM-1 is measured from the lower left hand corner of the survey unit (at column E4).

Survey Unit RO-2-4

ROLB 2nd Floor Class 1 Survey Unit



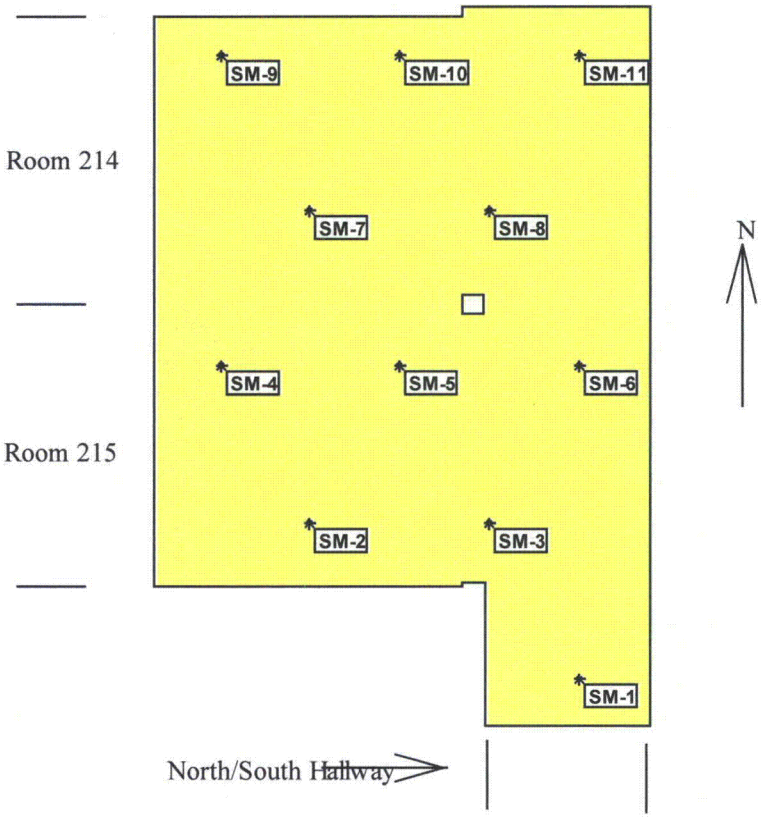
Survey Unit RO-2-4: ROLB 2nd Floor, Rooms 213-213A (floor) Class 1					
X Co-ord (m)	Y Co-ord (m)	Label	Value	Type	Notes
0.16	2.12	SM-1	120	Systematic	N/A
2.84	2.12	SM-2	352	Systematic	N/A
5.52	2.12	SM-3	520	Systematic	N/A
8.20	2.12	SM-4	-504	Systematic	N/A
1.50	4.44	SM-5	-48	Systematic	N/A
4.18	4.44	SM-6	496	Systematic	N/A
6.86	4.44	SM-7	368	Systematic	N/A
0.16	6.76	SM-8	416	Systematic	N/A
2.84	6.76	SM-9	728	Systematic	N/A
5.52	6.76	SM-10	256	Systematic	N/A
8.20	6.76	SM-11	544	Systematic	N/A

Table Notes:

1. Measurement locations are established on a triangular grid with randomly selected starting coordinates.
2. Measurement values are in units of dpm/100-cm^2.
3. All of the sample measurements are located by taking the lowest left-hand corner, of the surface on which they rest, as the origin.

Survey Unit RO-2-5

ROLB 2nd Floor Class 1 Survey Unit



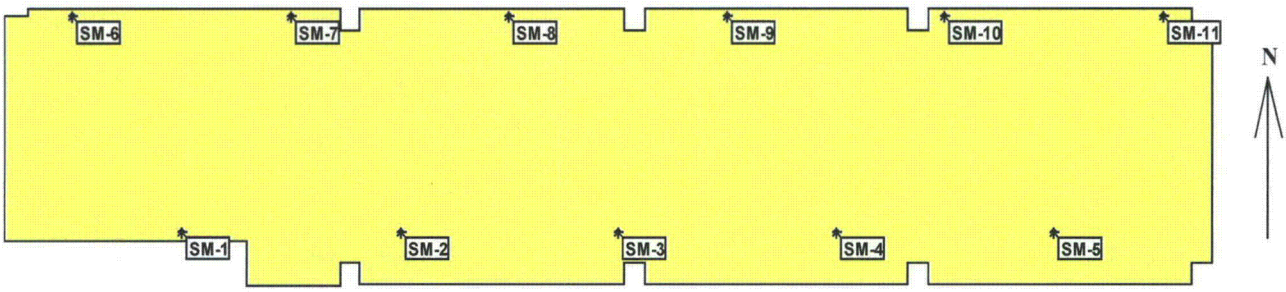
Survey Unit RO-2-5: ROLB 2nd Floor, Rooms 214-215, N-S Hallway (floors), Class 1					
X Co-ord (m)	Y Co-ord (m)	Label	Value	Type	Notes
1.41	0.71	SM-1	817	Systematic	Note 3
2.34	0.94	SM-2	693	Systematic	N/A
5.01	0.94	SM-3	700	Systematic	N/A
1.00	3.25	SM-4	109	Systematic	N/A
3.67	3.25	SM-5	-7.3	Systematic	N/A
6.34	3.25	SM-6	693	Systematic	N/A
2.34	5.57	SM-7	824	Systematic	N/A
5.01	5.57	SM-8	313	Systematic	N/A
1.00	7.88	SM-9	810	Systematic	N/A
3.67	7.88	SM-10	773	Systematic	N/A
6.34	7.88	SM-11	518	Systematic	N/A

Table Notes:

1. Measurement locations are established on a triangular grid with randomly selected starting coordinates.
2. Measurement values are in units of dpm/100-cm^2.
3. With exception of SM-1, all of the sample measurements are located by taking the lowest left-hand corner, of the surface on which they rest, as the origin. For example, SM-2 is measured from the southwest corner of Room 215. SM-1 is measured from the southwest corner of the North/South Hallway.

Survey Unit RO-2-6

ROLB 2nd Floor Class 1 Survey Unit



East/West Hallway

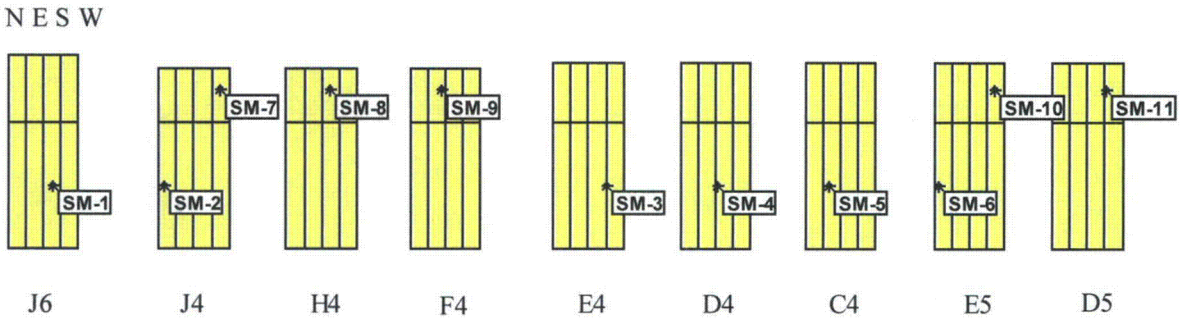
Survey Unit RO-2-6: ROLB 2nd Floor, E-W Hallway, Sections C-H (floors), Class 1					
X Co-ord (m)	Y Co-ord (m)	Label	Value	Type	Notes
2.69	0.10	SM-1	812	Systematic	Note 3
5.96	0.10	SM-2	315	Systematic	N/A
9.24	0.10	SM-3	483	Systematic	N/A
12.51	0.10	SM-4	752	Systematic	N/A
15.78	0.10	SM-5	678	Systematic	N/A
1.06	2.94	SM-6	756	Systematic	N/A
4.33	2.94	SM-7	456	Systematic	N/A
7.60	2.94	SM-8	101	Systematic	N/A
10.87	2.94	SM-9	678	Systematic	N/A
14.14	2.94	SM-10	812	Systematic	N/A
17.42	2.94	SM-11	792	Systematic	N/A

Table Notes:

1. Measurement locations are established on a triangular grid with randomly selected starting coordinates.
2. Measurement values are in units of dpm/100-cm^2.
3. All of the sample measurements are located by taking the lowest left-hand corner, of the surface on which they rest, as the origin. For example, SM-1 is measured from the south corner from where the North/South Hallway and the East/West Hallway meet.

Survey Unit RO-2-7

ROLB 2nd Floor Class 1 Survey Unit



Concrete Columns

KEY: N is the north face of the column

E is the east face of the column

S is the south face of the column

W is the west face of the column

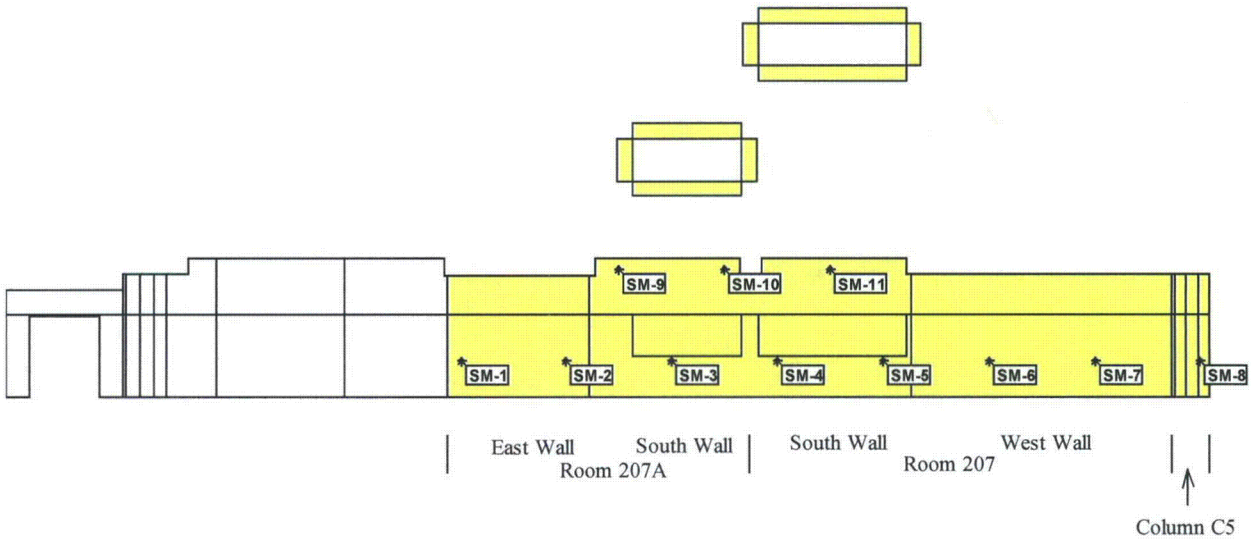
Survey Unit RO-2-7: ROLB 2nd Floor Columns, Class 1					
X Co-ord (m)	Y Co-ord (m)	Label	Value	Type	Notes
0.17	1.10	SM-1	606	Systematic	South column face
0.09	1.10	SM-2	701	Systematic	North column face
0.03	1.10	SM-3	693	Systematic	West column face
0.04	1.10	SM-4	323	Systematic	South column face
0.11	1.10	SM-5	598	Systematic	East column face
0.09	1.10	SM-6	843	Systematic	North column face
0.14	2.76	SM-7	811	Systematic	West column face
0.15	2.76	SM-8	378	Systematic	South column face
0.25	2.76	SM-9	535	Systematic	East column face
0.14	2.76	SM-10	890	Systematic	West column face
0.03	2.76	SM-11	858	Systematic	West column face

Table Notes:

1. Measurement locations are established on a triangular grid with randomly selected starting coordinates.
2. Measurement values are in units of dpm/100-cm^2.
3. All of the sample measurements are located by taking the lowest left-hand corner, of the surface on which they rest, as the origin. For example, SM-1 is measured on the south face from the lower left corner (against the floor).

Survey Unit RO-2-8

ROLB 2nd Floor Class 1 Survey Unit

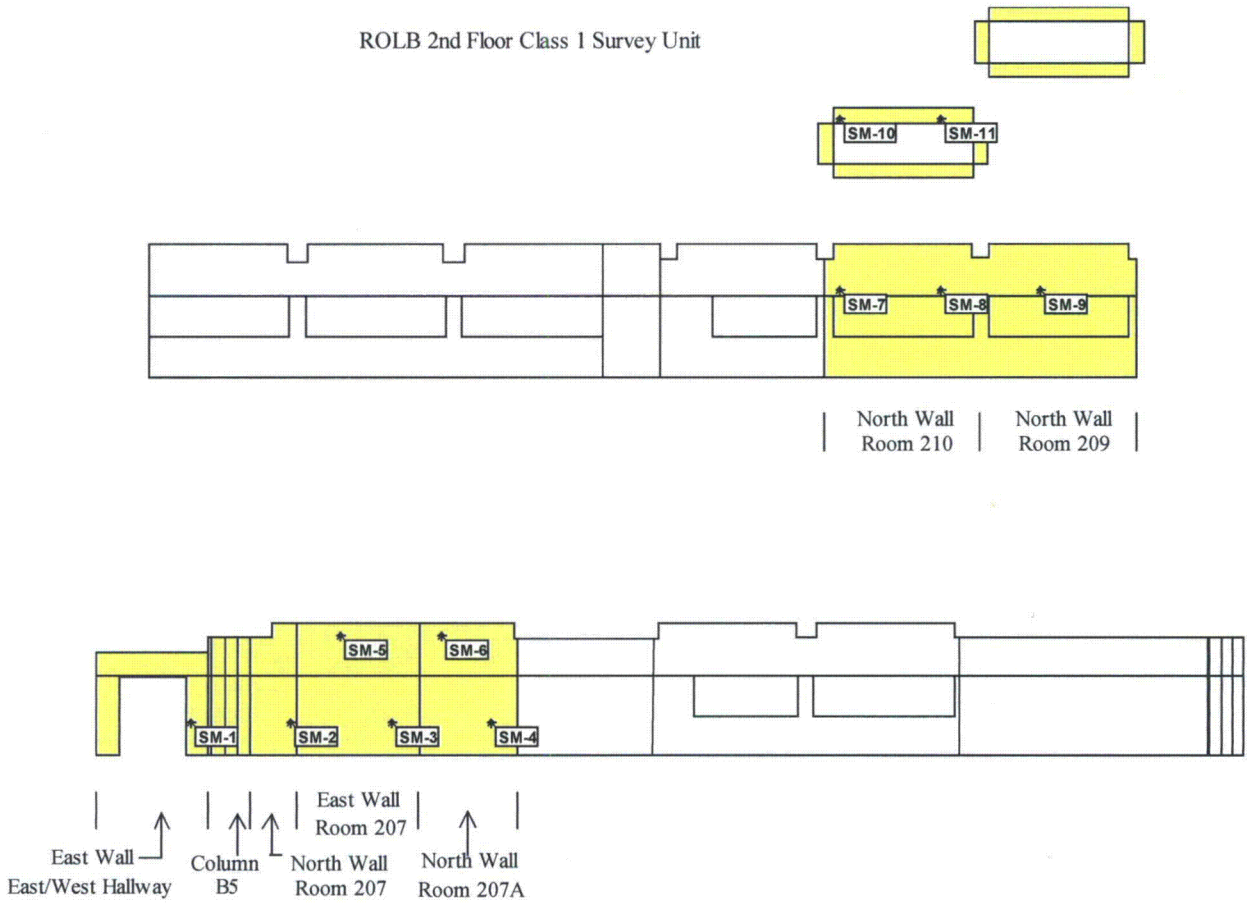


Survey Unit RO-2-8: ROLB 2nd Floor, Rooms 207 & 208, Wall Section 1, Class 1					
X Co-ord (m)	**Y Co-ord (m)**	**Label**	**Value**	**Type**	**Notes**
0.36	0.92	SM-1	-34	Systematic	N/A
3.12	0.92	SM-2	402	Systematic	N/A
2.17	0.92	SM-3	307	Systematic	N/A
-3.49	0.92	SM-4	394	Systematic	Measured from southwest corner of Room 207
-0.74	0.92	SM-5	402	Systematic	
2.01	0.92	SM-6	94	Systematic	N/A
4.76	0.92	SM-7	16	Systematic	N/A
0.07	0.92	SM-8	551	Systematic	West face of column C5
0.79	3.31	SM-9	71	Systematic	N/A
3.54	3.31	SM-10	8	Systematic	N/A
-2.12	3.31	SM-11	-47	Systematic	Measured from southwest corner of Room 207

Table Notes:

1. Measurement locations are established on a triangular grid with randomly selected starting coordinates.
2. Measurement values are in units of dpm/100-cm^2.
3. With the exception of SM-4, SM-5, and SM-11, all of the sample measurements are located by taking the lowest left-hand corner, of the surface on which they rest, as the origin. For example, SM-8 is measured, on the west face of column C5, from the lower left (north) corner. SM-4, SM5, and SM-11 are measured from the southwest corner of Room 207.

Survey Unit RO-2-9



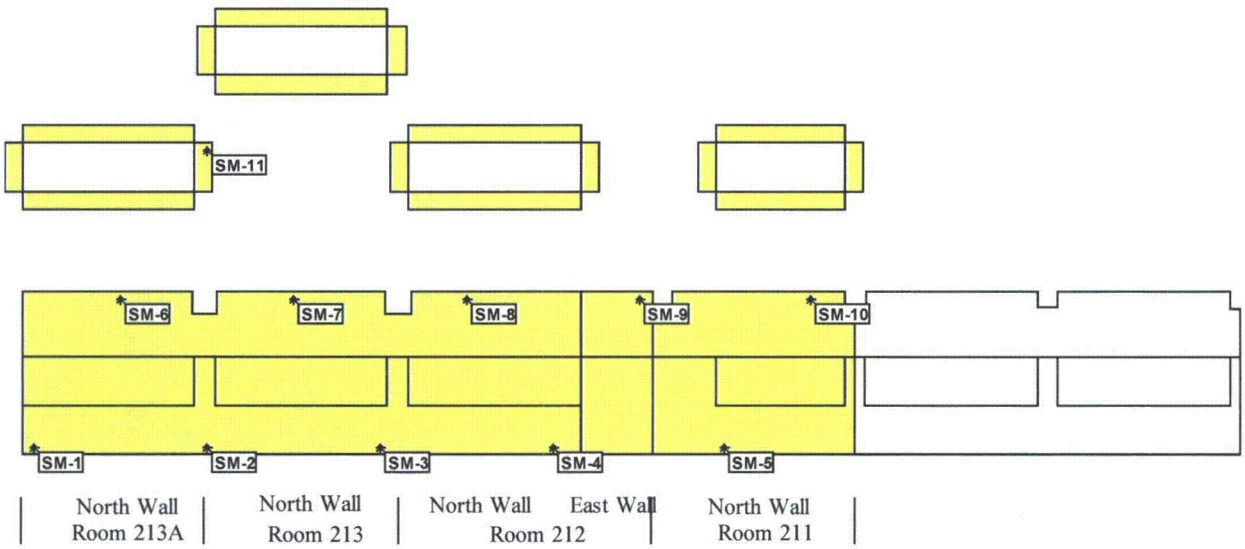
Survey Unit RO-2-9: ROLB 2nd Floor, Wall Section 2, Class 1,					
X Co-ord (m)	**Y Co-ord (m)**	**Label**	**Value**	**Type**	**Notes**
2.56	0.90	SM-1	-56	Systematic	N/A
1.11	0.90	SM-2	-216	Systematic	N/A
2.55	0.90	SM-3	62	Systematic	N/A
1.97	0.90	SM-4	-309	Systematic	N/A
1.19	3.27	SM-5	136	Systematic	N/A
0.60	3.27	SM-6	111	Systematic	N/A
0.41	2.34	SM-7	-99	Systematic	Measured from the approximate center of column E2
3.14	2.34	SM-8	-37	Systematic	
5.87	2.34	SM-9	1537	Systematic	
0.20	0.13	SM-10	31	Systematic	Upper sill
2.93	0.13	SM-11	354	Systematic	

Table Notes:

1. Measurement locations are established on a triangular grid with randomly selected starting coordinates.
2. Measurement values are in units of dpm/100-cm^2.
3. With the exception of SM-10 and SM-11, all of the sample measurements are located by taking the lowest left-hand corner, of the surface on which they rest, as the origin. For example, SM-1 is measured from the north corner of the East/West Hallway. SM-10 and SM-11 are measured from where the sill frame and the glass meet in Room 210.

Survey Unit RO-2-10

ROLB 2nd Floor Class 1 Survey Unit



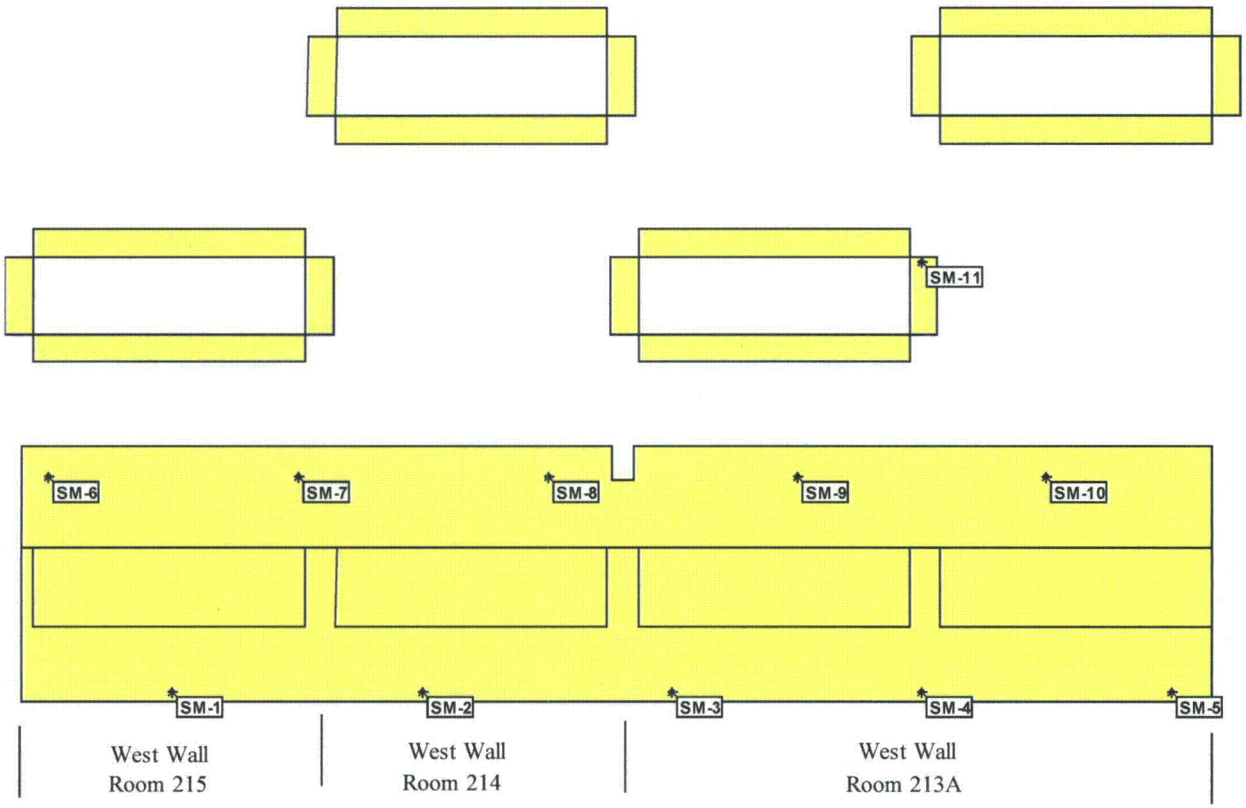
Survey Unit RO-2-10: ROLB 2nd Floor, Wall Section 3, Class 1					
X Co-ord (m)	Y Co-ord (m)	Label	Value	Type	Notes
0.28	0.13	SM-1	311	Systematic	Measured from the northwest corner of Room 213A
4.10	0.13	SM-2	335	Systematic	
7.93	0.13	SM-3	128	Systematic	
11.75	0.13	SM-4	274	Systematic	
1.62	0.13	SM-5	299	Systematic	N/A
2.19	3.44	SM-6	-24	Systematic	Measured from the northwest corner of Room 213A
6.01	3.44	SM-7	73	Systematic	
9.84	3.44	SM-8	159	Systematic	
1.32	3.44	SM-9	280	Systematic	N/A
3.53	3.44	SM-10	18	Systematic	N/A
0.29	0.93	SM-11	-18	Systematic	East side of window frame

Table Notes:

1. Measurement locations are established on a triangular grid with randomly selected starting coordinates.
2. Measurement values are in units of dpm/100-cm^2.
3. SM-5, SM-9, and SM-10 are measured from the lower left corner of the surface on which the sample measurements are located. Since walls have been removed from this survey unit, SM-1 through SM-4 and SM-6 through SM-8 are measured from the northwest corner of Room 213A. SM-11 is measured from where the sill frame and the glass meet in Room 213A.

Survey Unit RO-2-11

ROLB 2nd Floor Class 1 Survey Unit



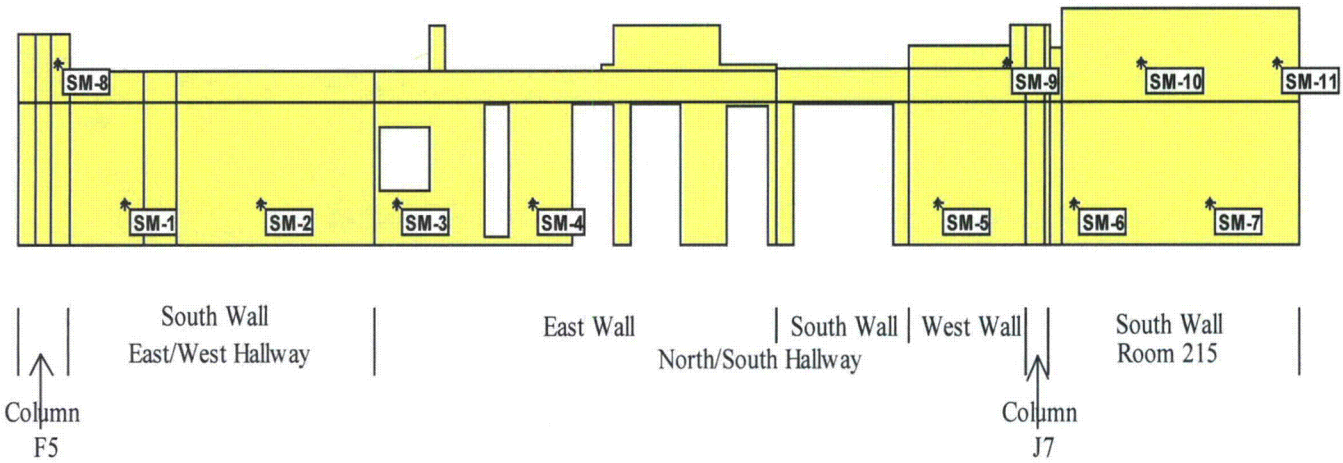
Survey Unit RO-2-11: ROLB 2nd Floor, Wall Section 4, Class 1					
X Co-ord (m)	Y Co-ord (m)	Label	Value	Type	Notes
2.14	0.12	SM-1	55	Systematic	Measured from the southwest corner of Room 215
5.66	0.12	SM-2	30	Systematic	
9.18	0.12	SM-3	-37	Systematic	
12.71	0.12	SM-4	287	Systematic	
16.23	0.12	SM-5	213	Systematic	
0.37	3.17	SM-6	-12	Systematic	
3.90	3.17	SM-7	238	Systematic	
7.42	3.17	SM-8	67	Systematic	
10.94	3.17	SM-9	6	Systematic	
14.47	3.17	SM-10	293	Systematic	
0.18	1.04	SM-11	232	Systematic	East side of window frame

Table Notes:

1. Measurement locations are established on a triangular grid with randomly selected starting coordinates.
2. Measurement values are in units of dpm/100-cm^2.
3. Since walls have been removed from this survey unit, SM-1 through SM-10 are measured from the southwest corner of Room 215. SM-11 is measured from where the sill frame and the glass meet in Room 213A.

Survey Unit RO-2-12

ROLB 2nd Floor Class 1 Survey Unit



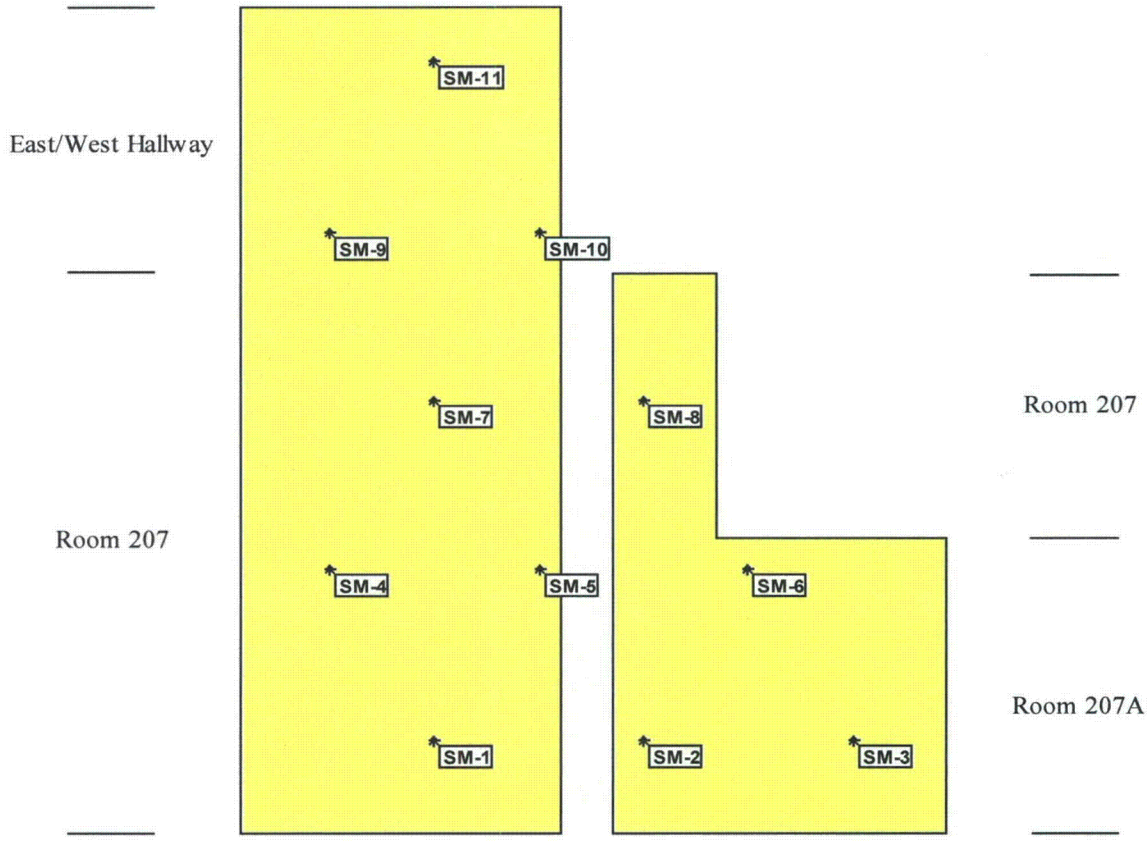
Survey Unit RO-2-12: ROLB 2nd Floor, Wall Section 5, Class 1					
X Co-ord (m)	Y Co-ord (m)	Label	Value	Type	Notes
1.04	0.63	SM-1	359	Systematic	N/A
1.57	0.63	SM-2	268	Systematic	N/A
0.42	0.63	SM-3	127	Systematic	N/A
2.92	0.63	SM-4	120	Systematic	N/A
0.54	0.63	SM-5	239	Systematic	N/A
0.46	0.63	SM-6	-113	Systematic	Measured from northwest corner of column J7
2.95	0.63	SM-7	-106	Systematic	
0.11	2.79	SM-8	535	Systematic	West face of column F5
1.79	2.79	SM-9	-106	Systematic	N/A
1.70	2.79	SM-10	99	Systematic	Measured from northwest corner of column J7
4.26	2.79	SM-11	-56	Systematic	

Table Notes:

1. Measurement locations are established on a triangular grid with randomly selected starting coordinates.
2. Measurement values are in units of dpm/100-cm^2.
3. With the exception of SM-6, SM-7, SM-10, and SM-11, all of the other sample measurements are located by taking the lowest left-hand corner, of the surface on which they rest, as the origin. For example, SM-5 is measured from the southwest corner of the north/south hallway at the double doors. SM-6, SM-7, SM-10, and SM-11 are measured from the northwest corner of column J7.

Survey Unit RO-2-13

ROLB 2nd Floor Class 1 Survey Unit



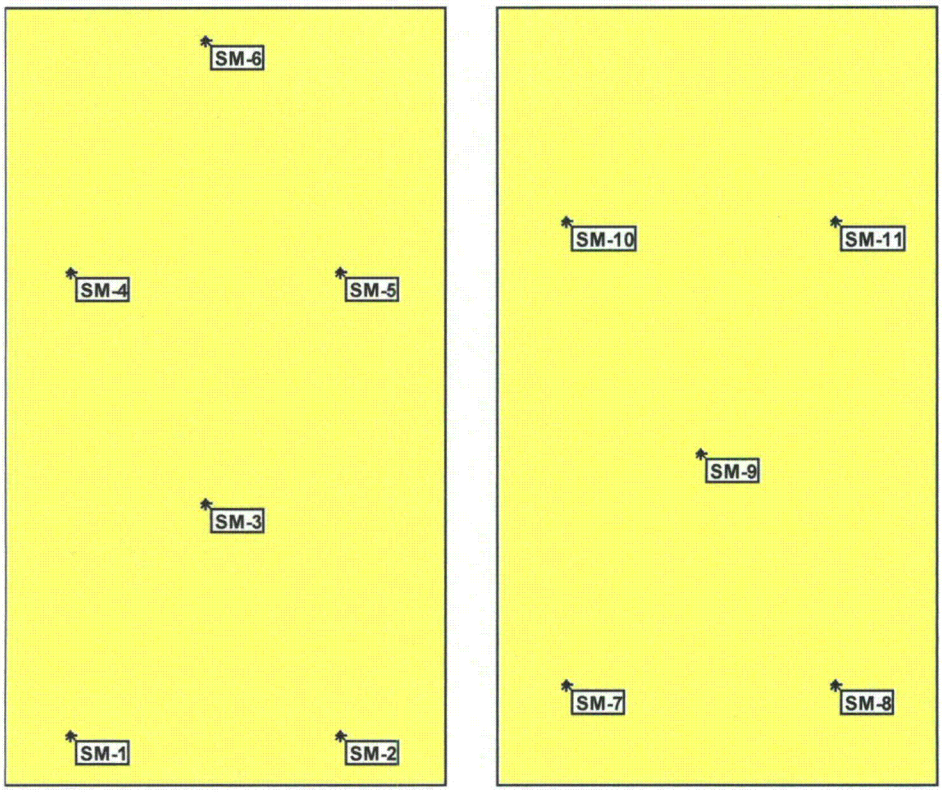
Survey Unit RO-2-13: ROLB 2nd Floor, Rooms 207, 207A, E-W Hallway (ceilings), Class 1					
X Co-ord (m)	Y Co-ord (m)	Label	Value	Type	Notes
2.26	1.18	SM-1	416	Systematic	Note 3
0.38	1.18	SM-2	453	Systematic	Note 3
2.84	1.18	SM-3	562	Systematic	Note 3
1.04	3.30	SM-4	547	Systematic	Note 3
3.49	3.30	SM-5	292	Systematic	Note 3
1.61	3.30	SM-6	504	Systematic	Note 3
2.26	5.43	SM-7	482	Systematic	Note 3
0.38	5.43	SM-8	584	Systematic	Note 3
1.04	7.55	SM-9	642	Systematic	Note 3
3.49	7.55	SM-10	482	Systematic	Note 3
2.26	9.68	SM-11	416	Systematic	Note 3

Table Notes:

1. Measurement locations are established on a triangular grid with randomly selected starting coordinates.
2. Measurement values are in units of dpm/100-cm^2.
3. SM-1, SM-4, SM-5, SM-7, SM-9, SM-10, and SM-11 are measured from the southwest corner of Room 207 at column C8. SM-2, SM-3, SM-6, and SM-8 are measured from the southwest corner of Room 207A at column B8.

Survey Unit RO-2-14

ROLB 2nd Floor Class 1 Survey Unit



Room 210 Ceiling

Room 209 Ceiling

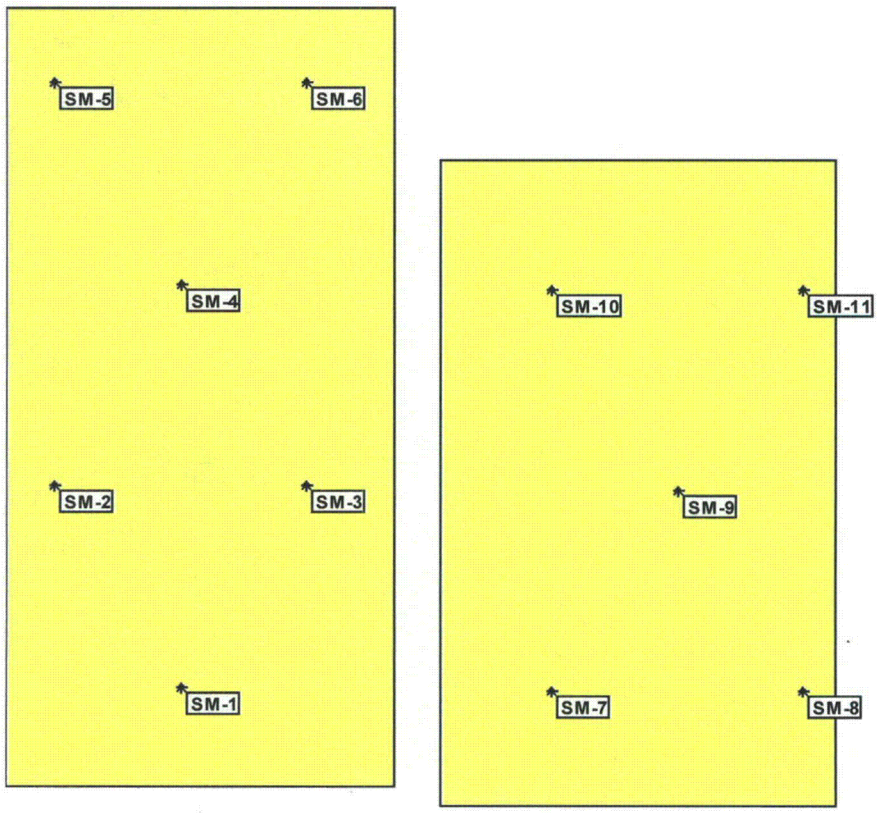
Survey Unit RO-2-14: ROLB 2nd Floor, Rooms 209 & 210 (ceilings), Class 1					
X Co-ord (m)	Y Co-ord (m)	Label	Value	Type	Notes
0.57	0.41	SM-1	920	Systematic	Note 3
2.90	0.41	SM-2	1139	Systematic	Note 3
1.73	2.42	SM-3	526	Systematic	Note 3
0.57	4.44	SM-4	526	Systematic	Note 3
2.90	4.44	SM-5	394	Systematic	Note 3
1.73	6.45	SM-6	1489	Systematic	Note 3
0.61	0.85	SM-7	861	Systematic	Note 3
2.93	0.85	SM-8	423	Systematic	Note 3
1.77	2.87	SM-9	423	Systematic	Note 3
0.61	4.88	SM-10	664	Systematic	Note 3
2.93	4.88	SM-11	387	Systematic	Note 3

Table Notes:

1. Measurement locations are established on a triangular grid with randomly selected starting coordinates.
2. Measurement values are in units of dpm/100-cm^2.
3. SM-1 through SM-6 are measured from the southwest corner of Room 210. SM-7 through SM-11 are measured from the southwest corner of Room 209.

Survey Unit RO-2-15

ROLB 2nd Floor Class 1 Survey Unit



Room 212 Ceiling

Room 211 Ceiling

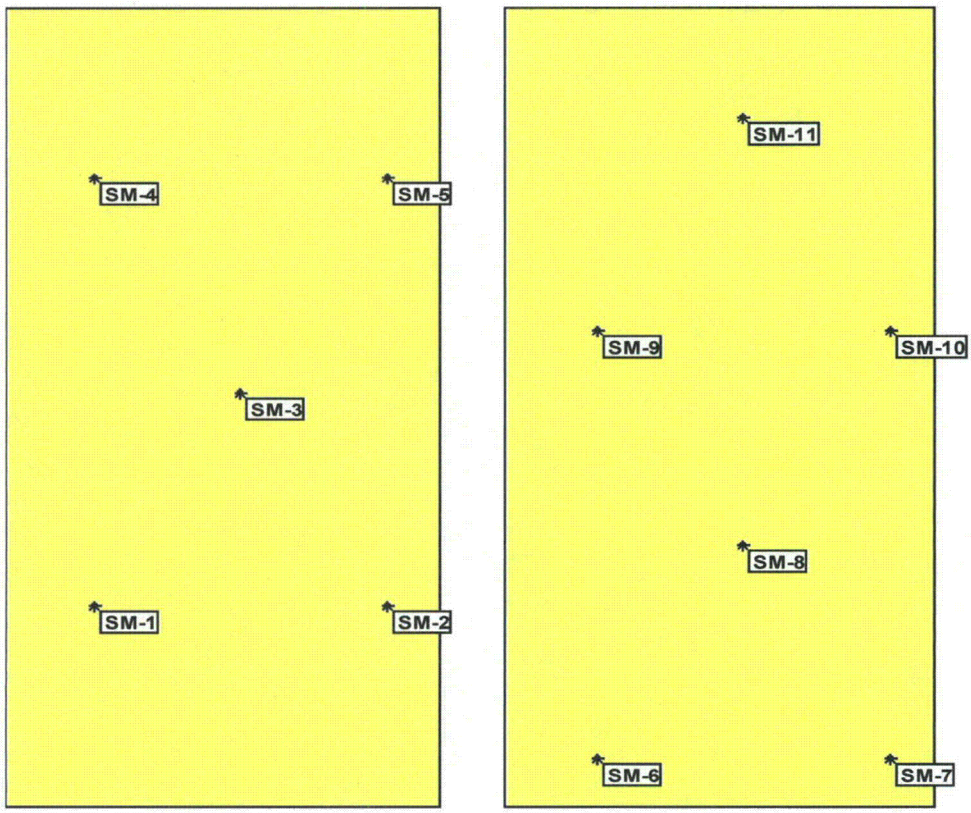
Survey Unit RO-2-15: ROLB 2nd Floor, Rooms 211 & 212 (ceilings), Class 1					
X Co-ord (m)	Y Co-ord (m)	Label	Value	Type	Notes
1.70	1.04	SM-1	1599	Systematic	Note 3
0.48	3.15	SM-2	467	Systematic	Note 3
2.91	3.15	SM-3	1679	Systematic	Note 3
1.70	5.25	SM-4	599	Systematic	Note 3
0.48	7.36	SM-5	270	Systematic	Note 3
2.91	7.36	SM-6	693	Systematic	Note 3
1.08	1.19	SM-7	613	Systematic	Note 3
3.52	1.19	SM-8	854	Systematic	Note 3
2.30	3.30	SM-9	146	Systematic	Note 3
1.08	5.41	SM-10	1321	Systematic	Note 3
3.52	5.41	SM-11	1073	Systematic	Note 3

Table Notes:

1. Measurement locations are established on a triangular grid with randomly selected starting coordinates.
2. Measurement values are in units of dpm/100-cm^2.
3. SM-1 through SM-6 are measured from the southwest corner of Room 212. SM-7 through SM-11 are measured from the southwest corner of Room 211.

Survey Unit RO-2-16

ROLB 2nd Floor Class 1 Survey Unit



Room 213A Ceiling Room 213 Ceiling

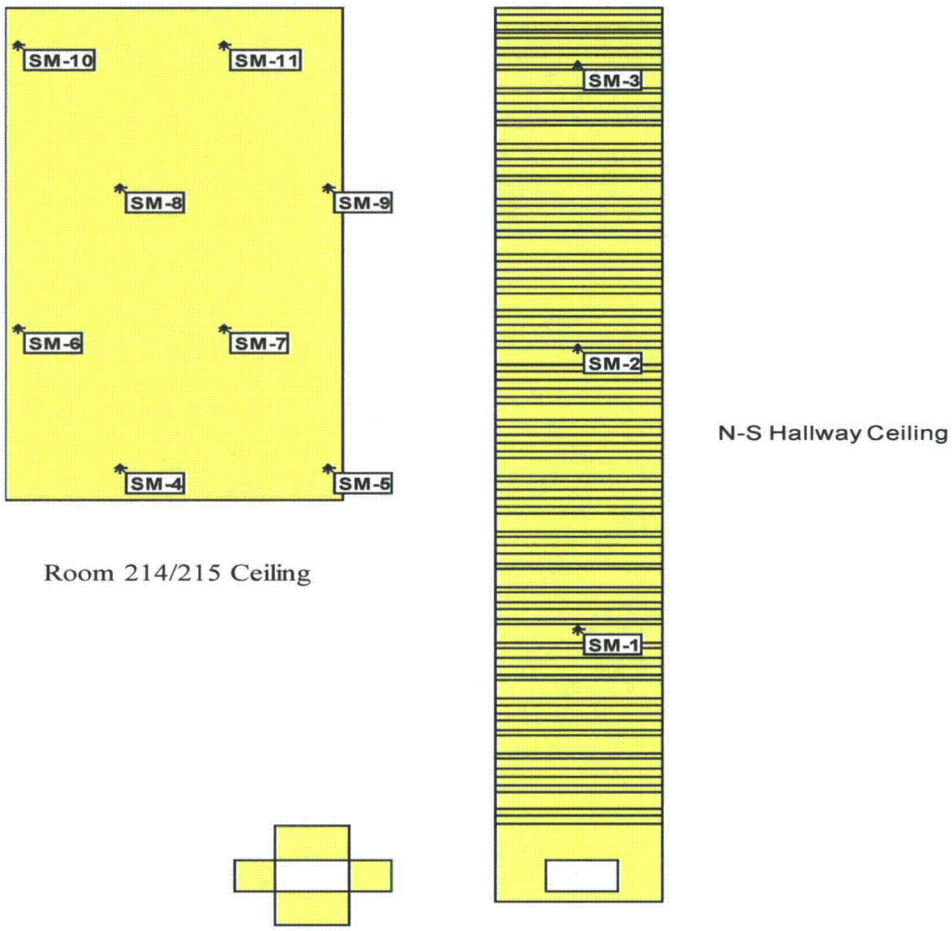
Survey Unit RO-2-16: ROLB 2nd Floor, Rooms 213/213A (ceilings), Class 1					
X Co-ord (m)	Y Co-ord (m)	Label	Value	Type	Notes
0.76	2.03	SM-1	431	Systematic	Note 3
3.29	2.03	SM-2	693	Systematic	Note 3
2.03	4.22	SM-3	161	Systematic	Note 3
0.76	6.41	SM-4	321	Systematic	Note 3
3.29	6.41	SM-5	511	Systematic	Note 3
0.80	0.47	SM-6	701	Systematic	Note 3
3.33	0.47	SM-7	1051	Systematic	Note 3
2.07	2.66	SM-8	438	Systematic	Note 3
0.80	4.85	SM-9	1051	Systematic	Note 3
3.33	4.85	SM-10	496	Systematic	Note 3
2.07	7.04	SM-11	613	Systematic	Note 3

Table Notes:

1. Measurement locations are established on a triangular grid with randomly selected starting coordinates.
2. Measurement values are in units of dpm/100-cm^2.
3. SM-1 through SM-5 are measured from the southwest corner of Room 213A. SM-6 through SM-11 are measured from the southwest corner of Room 213.

Survey Unit RO-2-17

ROLB 2nd Floor Class 1 Survey Unit



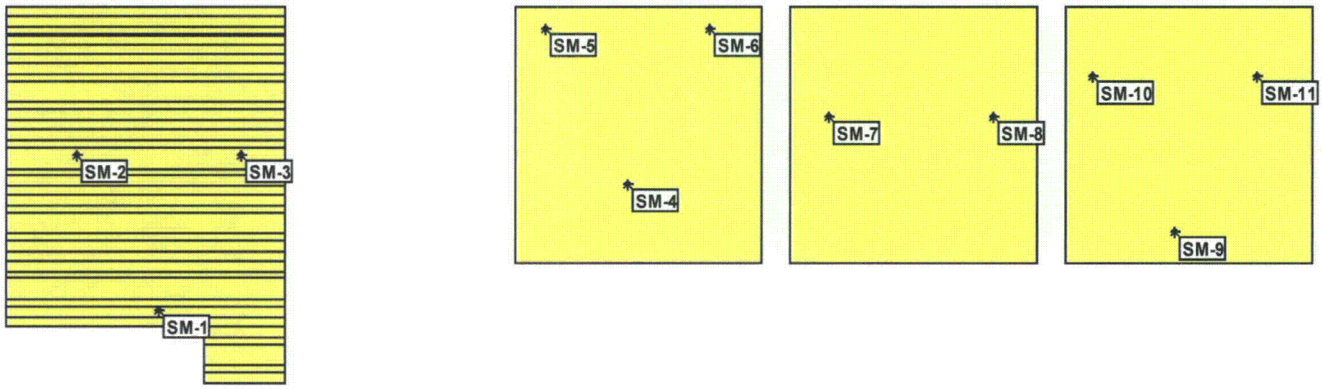
Survey Unit RO-2-17: ROLB 2nd Floor, Rooms 214, 125, N-S Hall (ceilings), Class 1					
X Co-ord (m)	Y Co-ord (m)	Label	Value	Type	Notes
1.09	4.58	SM-1	708	Systematic	Between 4th and 5th beam
1.09	9.34	SM-2	635	Systematic	South slanted surface of the 10th beam
1.09	14.11	SM-3	380	Systematic	South vertical surface of the 15th beam
1.55	0.51	SM-4	380	Systematic	N/A
4.30	0.51	SM-5	562	Systematic	N/A
0.18	2.90	SM-6	526	Systematic	N/A
2.93	2.90	SM-7	657	Systematic	N/A
1.55	5.28	SM-8	657	Systematic	N/A
4.30	5.28	SM-9	372	Systematic	N/A
0.18	7.67	SM-10	394	Systematic	N/A
2.93	7.67	SM-11	409	Systematic	N/A

Table Notes:

1. Measurement locations are on a triangular grid with randomly selected starting coordinates.
2. Measurement values are in units of dpm/100-cm^2.
3. SM-1 through SM-3 are measured from the southwest corner of the North/South Hallway. SM-4 through SM-11 are measured from the southwest corner of Room 215.

Survey Unit RO-2-18

ROLB 2nd Floor Class 1 Survey Unit



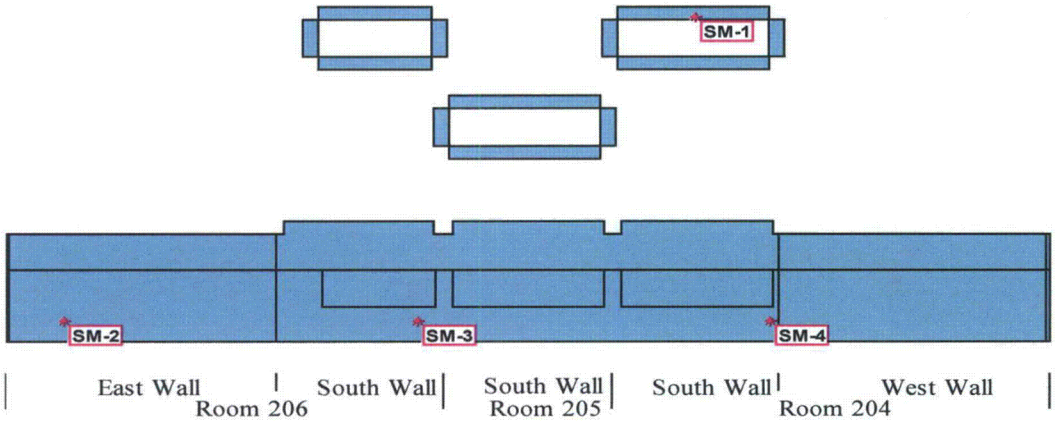
Survey Unit RO-2-18: ROLB 2nd Floor, E-W Hall, Section C-H (ceiling), Class 1					
X Co-ord (m)	Y Co-ord (m)	Label	Value	Type	Notes
2.41	0.20	SM-1	409	Systematic	Measured from the SW corner of where the E/W hall meets the N/S hall
1.13	2.41	SM-2	971	Systematic	
3.69	2.41	SM-3	766	Systematic	
1.74	1.11	SM-4	555	Systematic	F4/F5 roof beam at column F5
0.47	3.33	SM-5	555	Systematic	
3.02	3.33	SM-6	504	Systematic	
0.60	2.05	SM-7	715	Systematic	E4/E5 roof beam at column E5
3.15	2.05	SM-8	460	Systematic	
1.69	0.40	SM-9	321	Systematic	D4/D5 roof beam at column D5
0.41	2.61	SM-10	693	Systematic	
2.97	2.61	SM-11	577	Systematic	

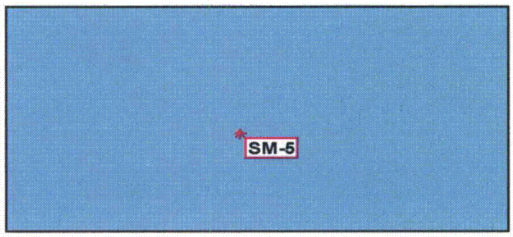
Table Notes:

1. Measurement locations are established on a triangular grid with randomly selected starting coordinates.
2. Measurement values are in units of dpm/100-cm^2.
3. SM-4 through SM-11 are measured from the east side of the roof beam even with the southeast corner of the respective column.

Survey Unit RO-2-19
(Page 1 of 3)

ROLB 2nd Floor Class 2 Survey Unit





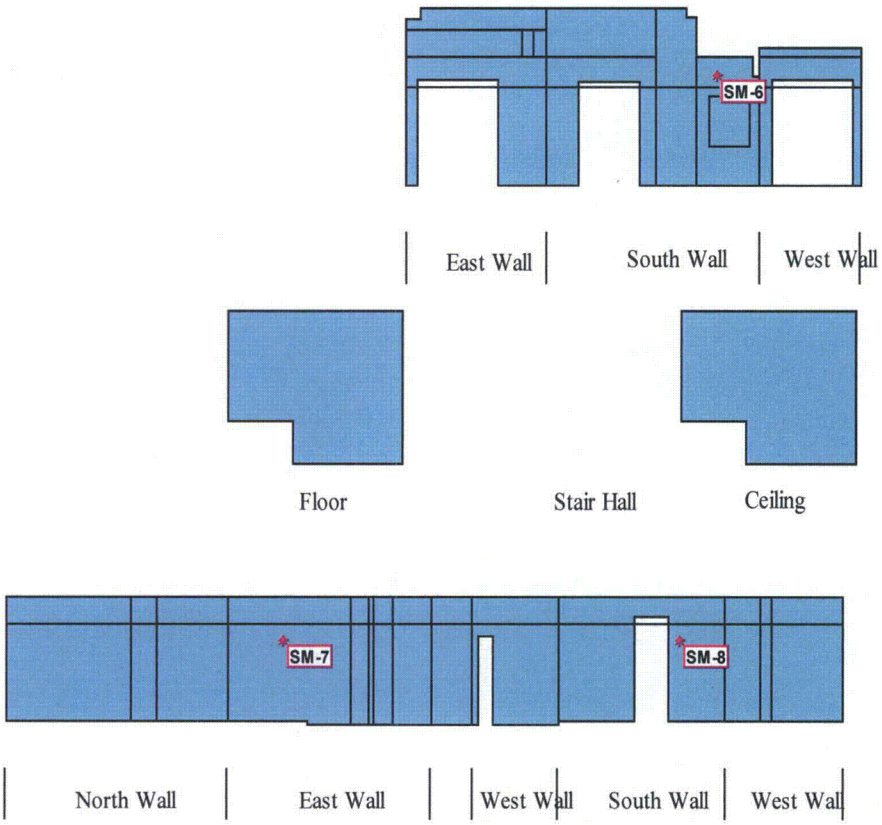
Rms. 204/205/206 Floor

Survey Unit RO-2-19: ROLB 2nd Floor, Class 2 Areas					
X Co-ord (m)	Y Co-ord (m)	Label	Value	Type	Notes
1.96	0.12	SM-1	44	Systematic	Measured from east side of frame against the glass
1.43	0.63	SM-2	-36	Systematic	Measured from northeast corner of Rm. 206 inside of column C5
3.53	0.63	SM-3	204	Systematic	Measured from southeast corner of Rm. 206
-0.24	0.63	SM-4	482	Systematic	Measured from southwest corner of Rm. 204
5.90	2.93	SM-5	650	Systematic	N/A
0.45	2.26	SM-6	161	Systematic	N/A
1.23	1.66	SM-7	-73	Systematic	N/A
2.70	1.66	SM-8	234	Systematic	N/A
2.29	0.83	SM-9	2204	Systematic	See survey maps for location points to measure from
-0.27	0.97	SM-10	73	Systematic	
-0.02	1.74	SM-11	1810	Systematic	

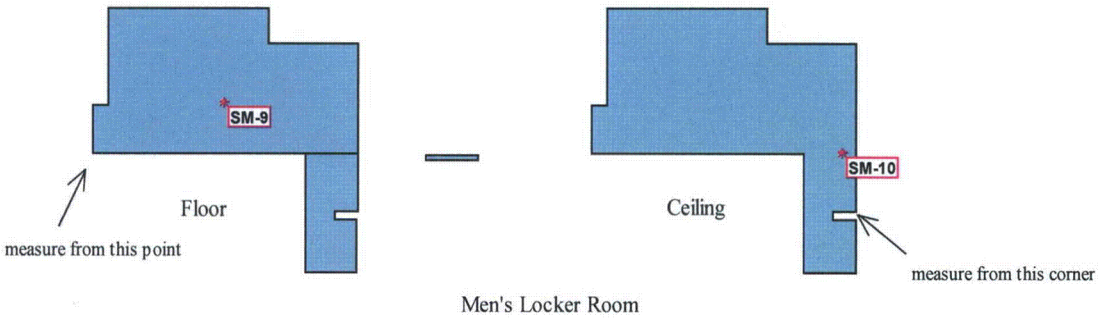
Table Notes:

1. Measurement locations are located on a triangular grid with randomly selected starting coordinates.
2. Measurement values are in units of dpm/100-cm^2.
3. All of the sample measurements are located by taking the lowest left-hand corner, of the surface on which they rest, as the origin. For example, the location of SM-3 is measured from the lower left hand corner of the survey unit (southeast corner of Room 206).

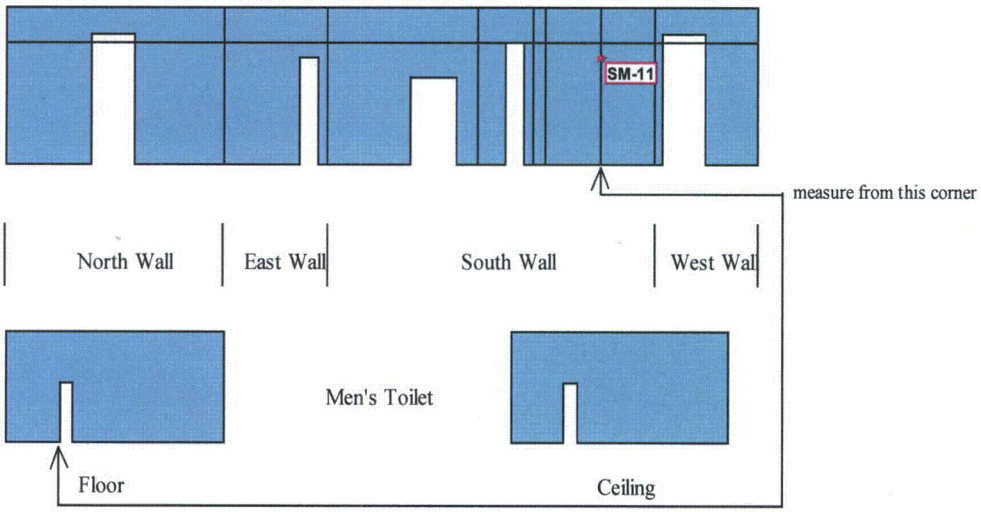
Survey Unit RO-2-19
(Page 2 of 3)



Survey Unit RO-2-19
(Page 3 of 3)

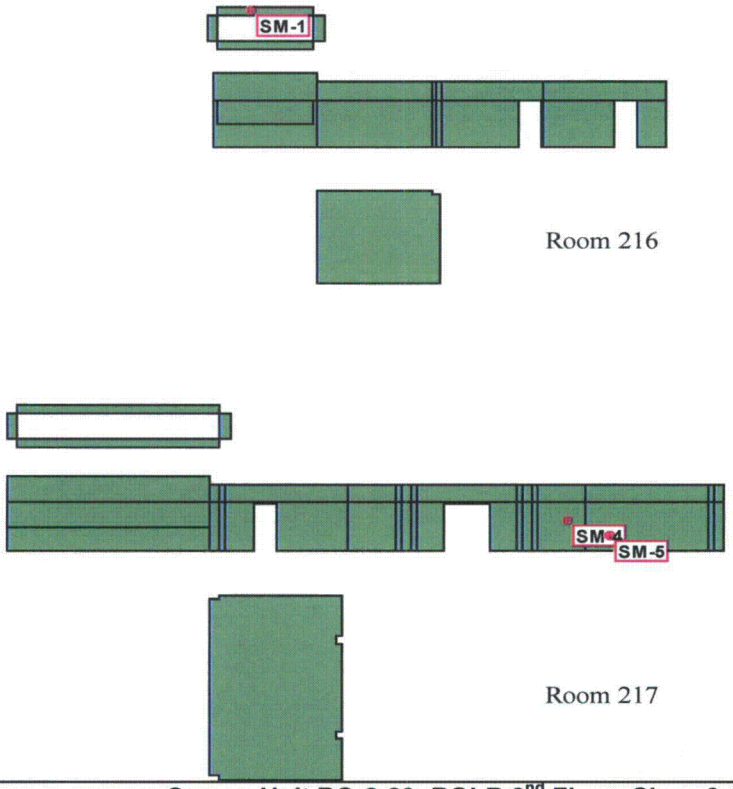


Men's Locker Room



Survey Unit RO-2-20
(Page 1 of 4)

ROLB 2nd Floor Class 3 Survey Unit

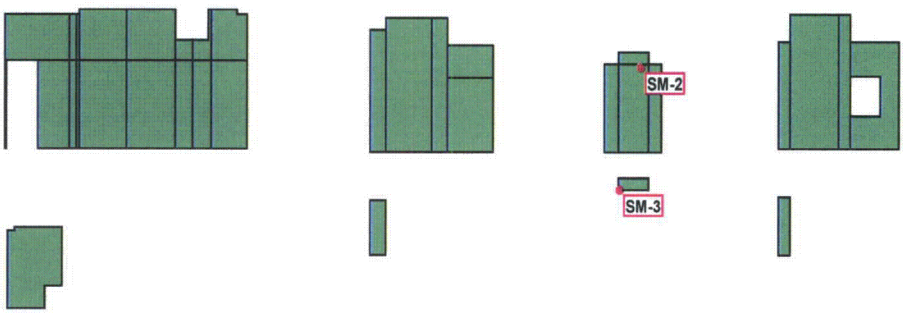


Survey Unit RO-2-20: ROLB 2nd Floor, Class 3 Areas					
X Co-ord (m)	Y Co-ord (m)	Label	Value	Type	Notes
1.28	0.21	SM-1	-85	Random	Measured from south side of window ledge against the glass
0.66	2.09	SM-2	-42	Random	Measured from the NE corner
0.02	0.02	SM-3	676	Random	Measured from NW corner of floor
-0.75	1.38	SM-4	42	Random	Measured from the SE corner of the room
0.93	0.71	SM-5	56	Random	
1.78	1.61	SM-6	648	Random	Measured from the SW corner
1.87	3.29	SM-7	697	Random	Measured from the SW corner
2.28	3.54	SM-8	535	Random	Measured from the SW corner
-0.25	2.05	SM-9	-169	Random	Measured from the SE corner of the room
-2.28	2.35	SM-10	387	Random	Measured from the SE corner of the room
-0.80	3.25	SM-11	465	Random	

Table Notes:

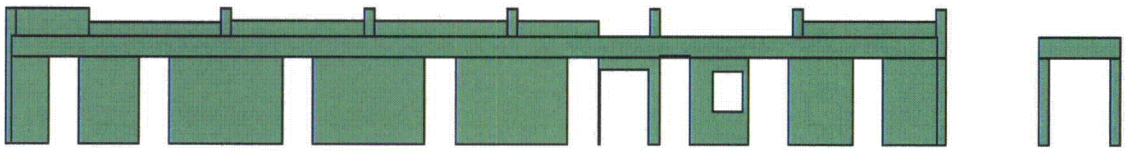
1. Measurement locations are selected on a random basis – Class 3 survey unit.
2. Measurement values are in units of dpm/100-cm^2.
3. See the Table notes for locating measurement points in each room. The notes indicate that there are different reference points in each room which are used as the origin. For example, the location of SM-4 and SM-5 are on different walls, but are measured from the same point: the southeast corner of Room 217.

Survey Unit RO-2-20
(Page 2 of 4)

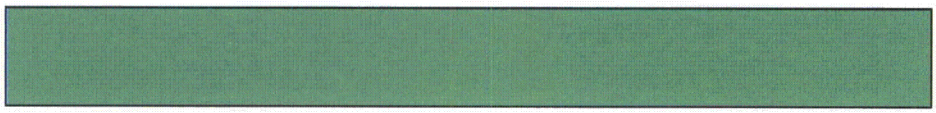


Janitor Closet | Cubby Hole | 200A | Fire Extinguisher

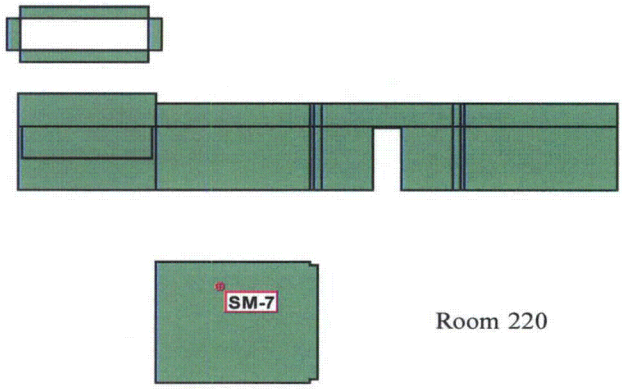
East Wall

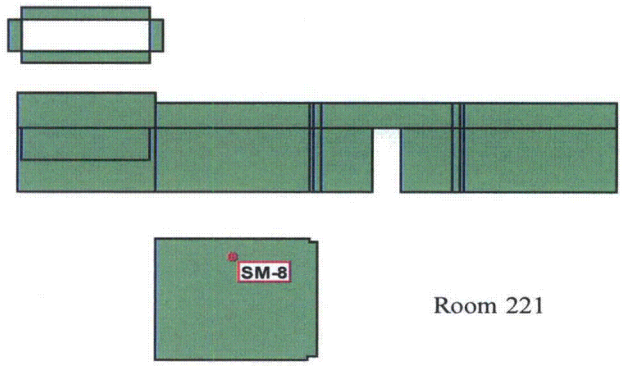


North/South Hallway

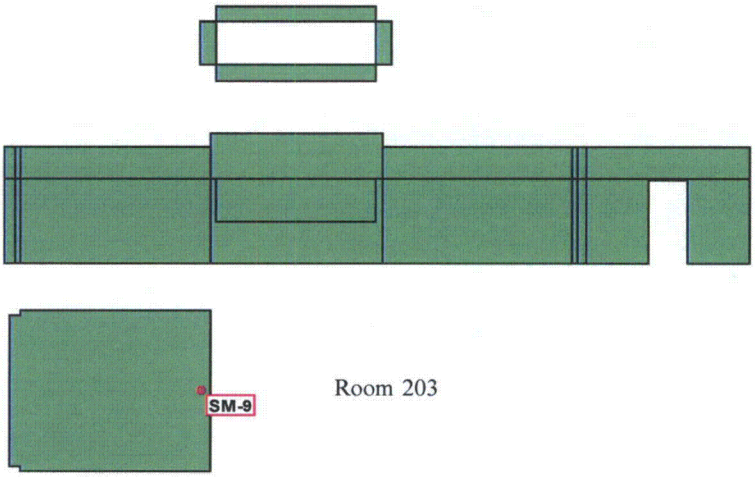


Survey Unit RO-2-20
(Page 3 of 4)



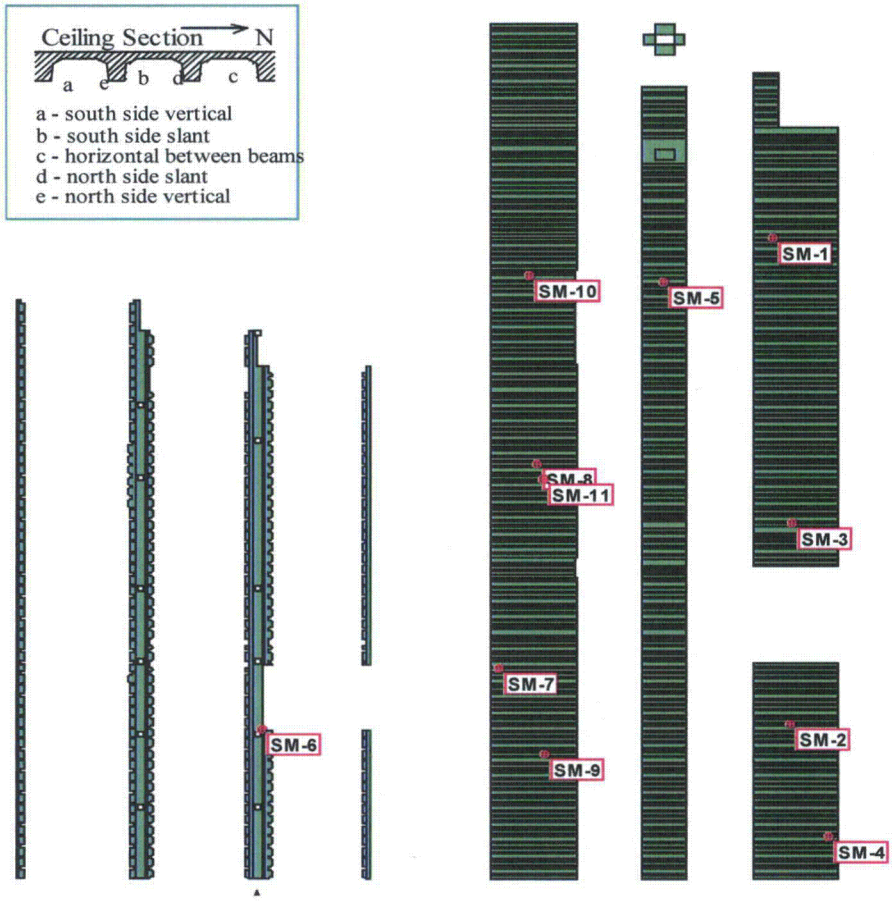


Survey Unit RO-2-20
(Page 4 of 4)



Survey Unit RO-2-21

ROLB 2nd Floor Class 3 Survey Unit



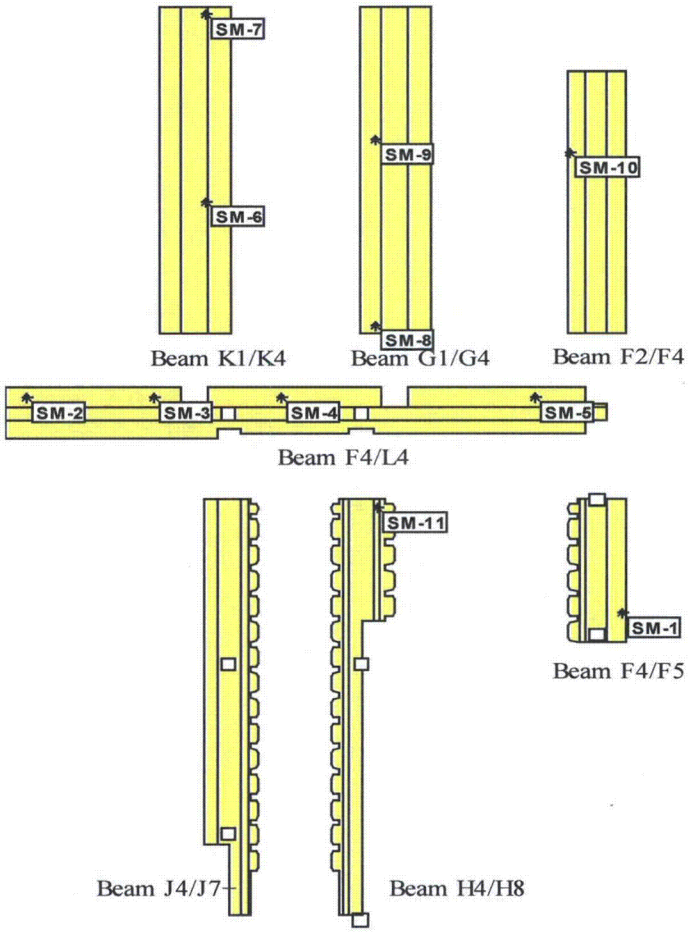
Survey Unit RO-2-21: ROLB 2nd Floor, Class 3 Areas (ceilings)					
X Co-ord (m)	Y Co-ord (m)	Label	Value	Type	Notes
1.04	N/A	SM-1	824	Random	North side 41st beam vertical surface
1.91	N/A	SM-2	908	Random	South side 11th beam vertical surface
1.99	N/A	SM-3	563	Random	North side 23rd beam
3.91	N/A	SM-4	401	Random	South side 4th beam slant
1.01	N/A	SM-5	880	Random	Between 38th & 39th beam
0.02	0.13	SM-6	817	Random	Measured from NE corner of column H16
0.43	N/A	SM-7	690	Random	North side 14th beam slant
2.39	N/A	SM-8	211	Random	South side 27th beam vertical surface
2.79	N/A	SM-9	500	Random	South side 9th beam vertical surface
1.97	N/A	SM-10	810	Random	South side 39th beam slant
2.70	N/A	SM-11	873	Random	South side 26th beam vertical surface

Table Notes:

1. Measurement locations are selected on a random basis – Class 3 survey unit.
2. Measurement values are in units of dpm/100-cm^2.
3. With the exception of SM-6, all other X co-ordinates are taken from the west side of the ceiling. With the exception of SM-6, no Y co-ordinates are given as the surfaces are very small so that the probe may just fit onto them. The "slant" refers to the short transition between the vertical beam and the horizontal ceiling.

Survey Unit RO-2-22

ROLB 2nd Floor Class 1 Survey Unit



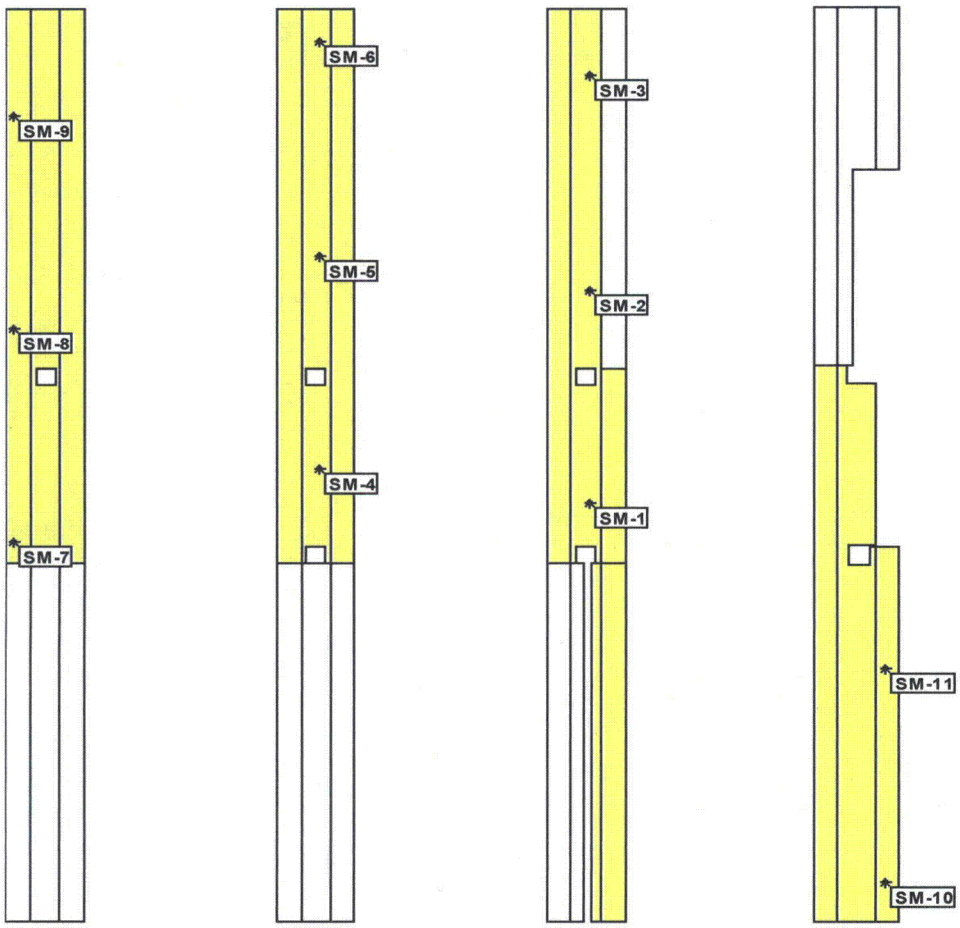
Survey Unit RO-2-22: ROLB 2nd Floor Ceiling Beams, Class 1					
X Co-ord (m)	Y Co-ord (m)	Label	Value	Type	Notes
-2.83	0.31	SM-1	832	Systematic	Measured from where beam F4/F5 meets beam F4/L4
0.50	0.20	SM-2	664	Systematic	Measured from where beam F4/L4 meets column L4
3.20	0.20	SM-3	657	Systematic	
1.59	0.20	SM-4	642	Systematic	Measured from where beam K1/K4 meets beam F4/L4
2.68	0.20	SM-5	343	Systematic	Measured from where beam G1/G4 meets beam F4/L4
3.31	0.01	SM-6	482	Systematic	Measured from where beam K1/K4 meets beam F4/L4
7.98	0.01	SM-7	438	Systematic	
0.17	0.13	SM-8	292	Systematic	Measured from where beam G1/G4 meets beam F4/L4
4.83	0.13	SM-9	394	Systematic	
4.50	0.33	SM-10	839	Systematic	Measured from where beam F2/F4 meets beam F4/L4
-0.22	0.10	SM-11	467	Systematic	Measured from where beam H4/H8 meets beam F4/L4

Table Notes:

1. Measurement locations are established on a triangular grid with randomly selected starting coordinates.
2. Measurement values are in units of dpm/100-cm^2.
3. See the Notes above for how to locate where sample measurements were taken. For example, SM-1 is measured from the north end of Beam F4/F5 (where it intersects Beam F4/L4) south 2.83 meters and then up (toward the ceiling) 0.31 meters.

Survey Unit RO-2-23

ROLB 2nd Floor Class 1 Survey Unit



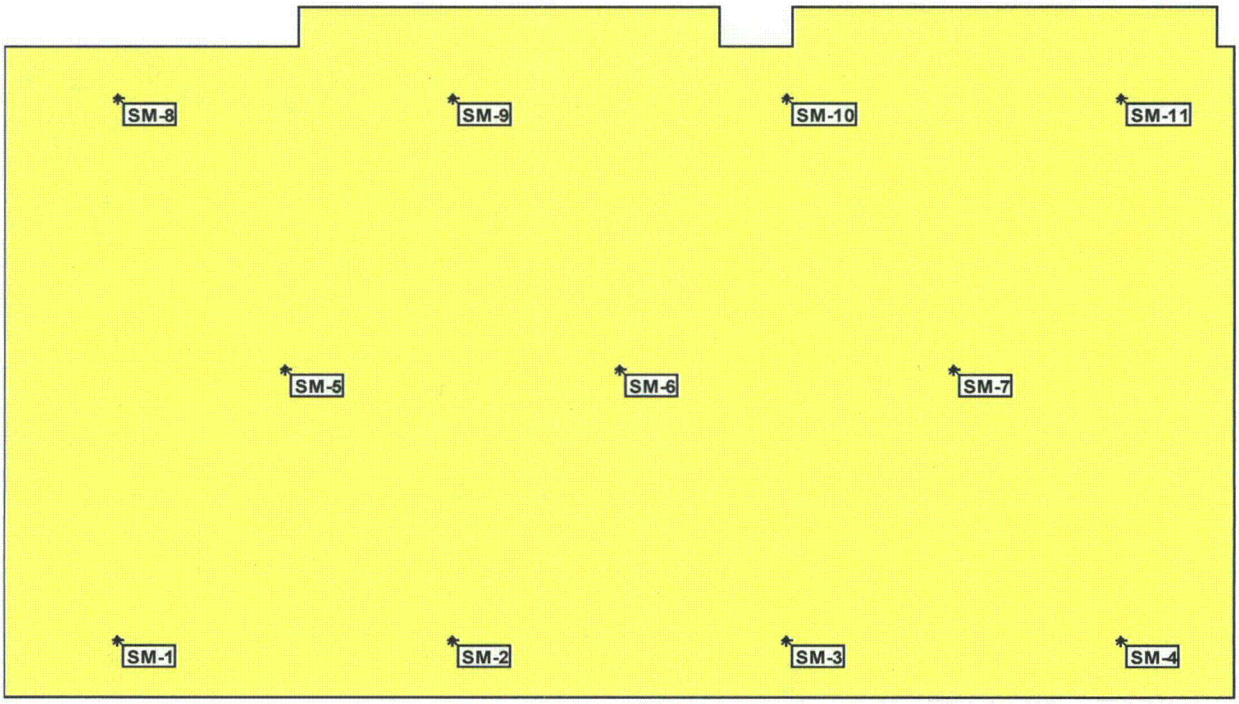
Survey Unit RO-2-23: ROLB 2nd Floor Ceiling Beams, Class 1,					
X Co-ord (m)	Y Co-ord (m)	Label	Value	Type	Notes
-9.31	0.32	SM-1	533	Systematic	Measured from where beam C2/C8 meets the north wall
-5.30	0.32	SM-2	511	Systematic	
-1.28	0.32	SM-3	504	Systematic	
-8.66	0.28	SM-4	401	Systematic	Measured from where beam D2/D5 meets the north wall
-4.64	0.28	SM-5	387	Systematic	
-0.63	0.28	SM-6	438	Systematic	
-10.04	0.24	SM-7	482	Systematic	Measured from where beam E2/E5 meets the north wall
-6.03	0.24	SM-8	307	Systematic	
-2.02	0.24	SM-9	584	Systematic	
0.73	0.17	SM-10	285	Systematic	Measured from where beam B2/B8 meets the south wall
4.74	0.17	SM-11	175	Systematic	

Table Notes:

1. Measurement locations are established on a triangular grid with randomly selected starting coordinates.
2. Measurement values are in units of dpm/100-cm^2.
3. See the Notes above for how to locate where sample measurements were taken. For example, SM-9 is measured from the north end of Beam E2/E5 (where it intersects with the north wall) south 9.31 meters and then up (toward the ceiling) 0.32 meters.

Survey Unit RO-3-1

ROLB Basement Class 1 Survey Unit - Areaway Room 5 Floor



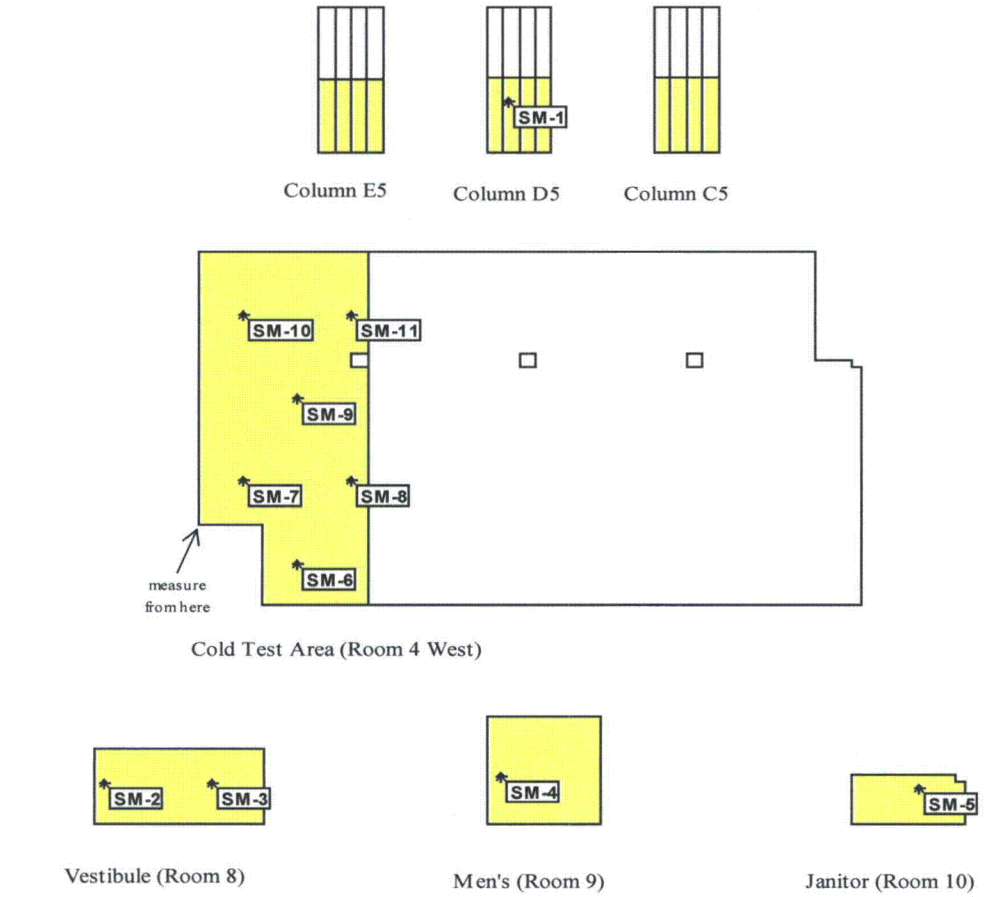
Survey Unit RO-3-1: ROLB Basement, Areaway (floor), Class 1					
X Co-ord (m)	Y Co-ord (m)	Label	Value	Type	Notes
0.98	0.54	SM-1	841	Systematic	Note 3
3.86	0.54	SM-2	1265	Systematic	Note 3
6.74	0.54	SM-3	932	Systematic	Note 3
9.62	0.54	SM-4	894	Systematic	Note 3
2.42	3.03	SM-5	1015	Systematic	Note 3
5.30	3.03	SM-6	818	Systematic	Note 3
8.18	3.03	SM-7	1091	Systematic	Note 3
0.98	5.53	SM-8	1030	Systematic	Note 3
3.86	5.53	SM-9	1159	Systematic	Note 3
6.74	5.53	SM-10	1114	Systematic	Note 3
9.62	5.53	SM-11	1008	Systematic	Note 3

Table Notes:

1. Measurement locations are established on a triangular grid with randomly selected starting coordinates.
2. Measurement values are in units of dpm/100-cm^2.
3. All of the sample measurements are located by taking the lowest left-hand corner, of the surface on which they rest, as the origin. For example, the location of SM-1 is measured from the south west corner of the Area Way (Room 5).

Survey Unit RO-3-2

ROLB Basement Class 1 Survey Unit - Vestibule, Mens Room, Janitor and Cold Test Area W. Floors, Lower Columns



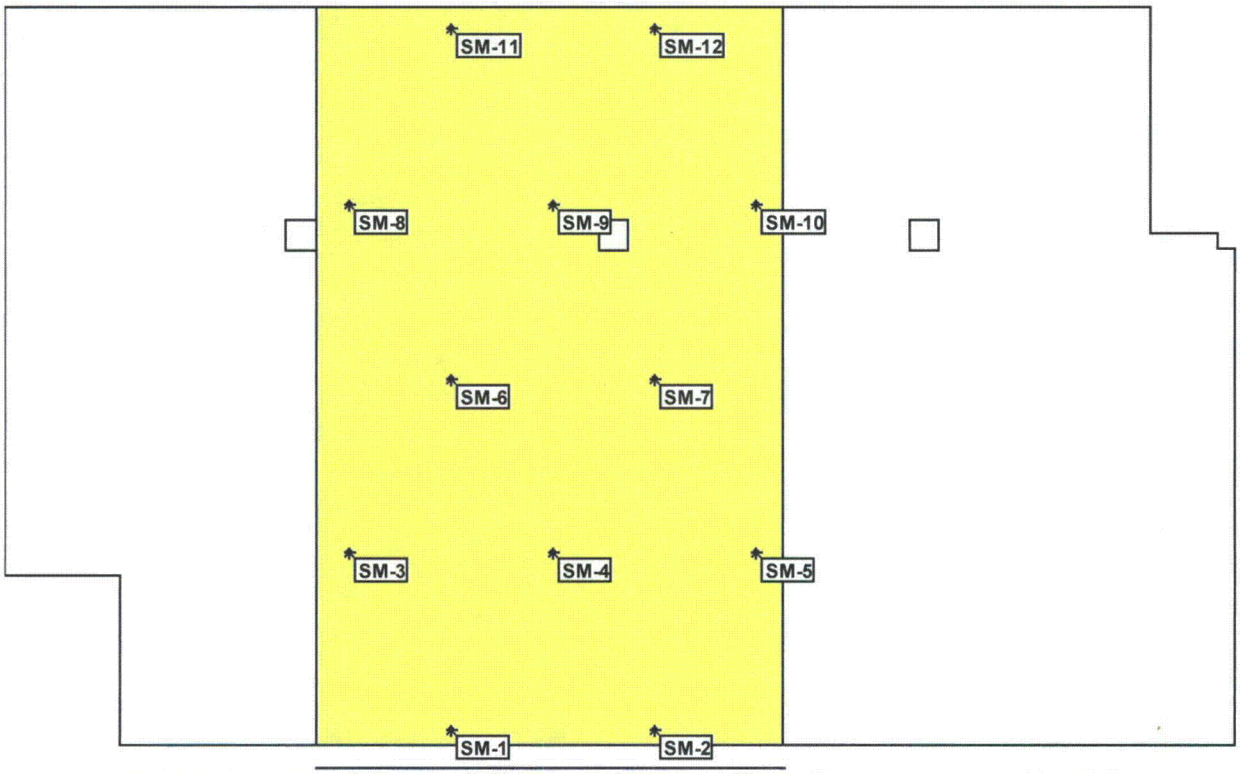
Survey Unit RO-3-2: ROLB 2nd Floor, Class 1 Areas (floors)					
X Co-ord (m)	Y Co-ord (m)	Label	Value	Type	Notes
0.14	1.49	SM-1	265	Systematic	Measured from NW corner of column D5
0.23	1.13	SM-2	886	Systematic	N/A
2.98	1.13	SM-3	841	Systematic	N/A
0.34	1.37	SM-4	500	Systematic	N/A
1.72	0.98	SM-5	811	Systematic	N/A
2.46	-1.14	SM-6	-106	Systematic	See drawing above for location of origin
1.09	1.24	SM-7	98	Systematic	
3.84	1.24	SM-8	712	Systematic	
2.46	3.62	SM-9	636	Systematic	
1.09	6.00	SM-10	621	Systematic	
3.84	6.00	SM-11	985	Systematic	

Table Notes:

1. Measurement locations are established on a triangular grid with randomly selected starting coordinates.
2. Measurement values are in units of dpm/100-cm^2.
3. All of the sample measurements are located by taking the lowest left-hand corner, of the surface on which they rest, as the origin. For example, the location of SM-1 is measured from the south west corner of the Vestibule (Room 8).

Survey Unit RO-3-3

ROLB Basement Class 1 Survey Unit, Cold Test Area (center) Floor



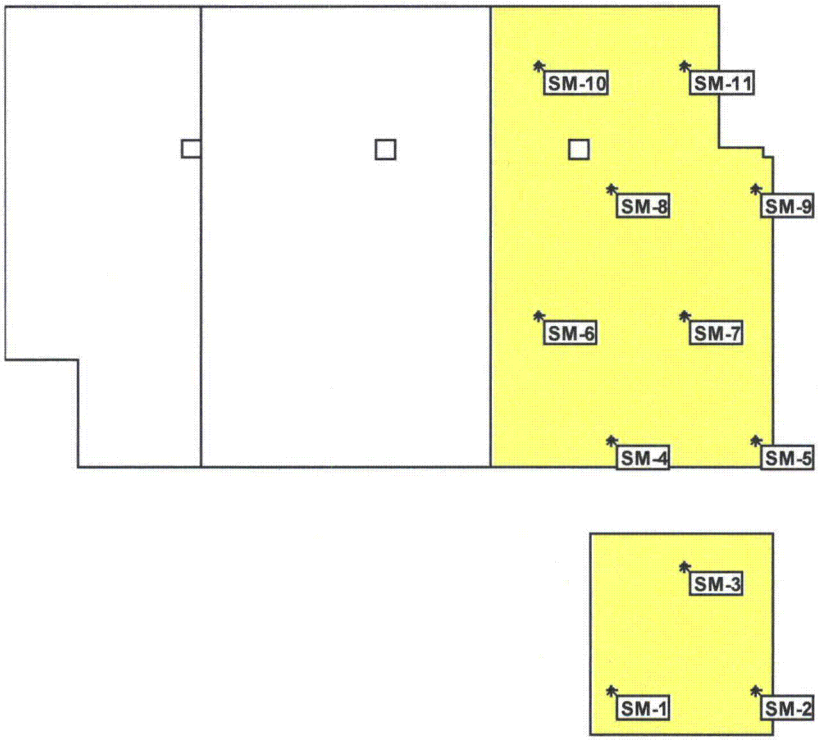
Survey Unit RO-3-3: ROLB Basement, Cold Test Area, Center (floor), Class 1					
X Co-ord (m)	Y Co-ord (m)	Label	Value	Type	Notes
1.85	0.23	SM-1	1250	Systematic	Note 3
4.63	0.23	SM-2	1121	Systematic	Note 3
0.46	2.63	SM-3	727	Systematic	Note 3
3.24	2.63	SM-4	803	Systematic	Note 3
6.02	2.63	SM-5	871	Systematic	Note 3
1.85	5.04	SM-6	735	Systematic	Note 3
4.63	5.04	SM-7	962	Systematic	Note 3
0.46	7.44	SM-8	735	Systematic	Note 3
3.24	7.44	SM-9	894	Systematic	Note 3
6.02	7.44	SM-10	924	Systematic	Note 3
1.85	9.85	SM-11	1061	Systematic	Note 3
4.63	9.85	SM-12	788	Systematic	Note 3

Table Notes:

1. Measurement locations are established on a triangular grid with randomly selected starting coordinates.
2. Measurement values are in units of dpm/100-cm^2.
3. All of the sample measurements are located by taking the lowest left-hand corner of the surface on which they rest as the origin. For example, SM-1 is measured from the south west corner of the Cold Test Area (center).

Survey Unit RO-3-4

ROLB Basement Class 1 Survey Unit, Cold Test Area (East) and Vault Floors



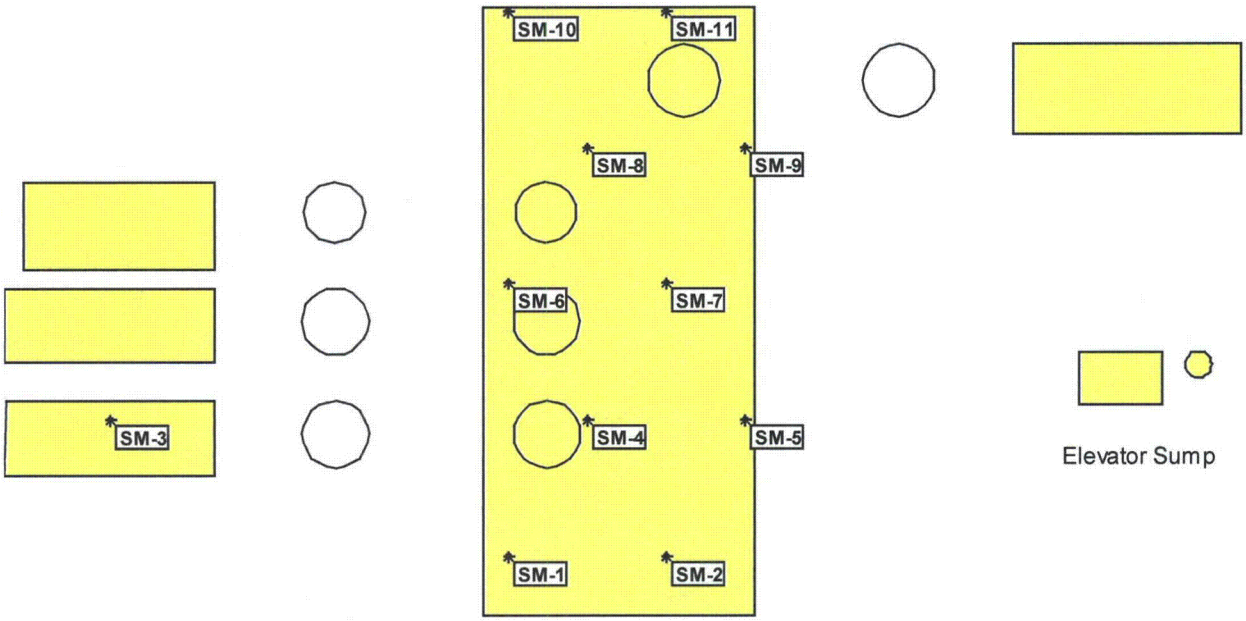
Survey Unit RO-3-4: ROLB Basement, Cold Test Area (East) & Vault (floors), Class 1					
X Co-ord (m)	Y Co-ord (m)	Label	Value	Type	Notes
0.43	0.95	SM-1	927	Systematic	N/A
3.61	0.95	SM-2	536	Systematic	N/A
2.02	3.71	SM-3	753	Systematic	N/A
-3.52	0.55	SM-4	783	Systematic	Measured from southeast corner of Cold Test Area (Room 4)
-0.34	0.55	SM-5	370	Systematic	
-5.12	3.31	SM-6	587	Systematic	
-1.93	3.31	SM-7	399	Systematic	
-3.52	6.07	SM-8	565	Systematic	
-0.34	6.07	SM-9	710	Systematic	
-5.12	8.83	SM-10	725	Systematic	
-1.93	8.83	SM-11	746	Systematic	

Table Notes:

1. Measurement locations are established on a triangular grid with randomly selected starting coordinates.
2. Measurement values are in units of dpm/100-cm^2.
3. Unless otherwise noted, all sample measurements are located by taking the lowest left-hand corner, of the surface on which they rest, as the origin. For example, the location of SM-1 is measured from the south west corner of the Vault (Room 17).

Survey Unit RO-3-5

ROLB Basement Class 1 Survey Unit, Sump Room Floor, sumps and Elevator Sump



Survey Unit RO-3-5: ROLB Basement, Sump Room, Sumps & Elevator Sump, Class 1					
X Co-ord (m)	Y Co-ord (m)	Label	Value	Type	Notes
0.44	1.00	SM-1	826	Systematic	Note 3
3.18	1.00	SM-2	803	Systematic	Note 3
1.82	-0.34	SM-3	323	Systematic	Note 3
1.81	3.37	SM-4	765	Systematic	Note 3
4.54	3.37	SM-5	902	Systematic	Note 3
0.44	5.74	SM-6	674	Systematic	Note 3
3.18	5.74	SM-7	1008	Systematic	Note 3
1.81	8.10	SM-8	856	Systematic	Note 3
4.54	8.10	SM-9	977	Systematic	Note 3
0.44	10.47	SM-10	1045	Systematic	Note 3
3.18	10.47	SM-11	568	Systematic	Note 3

Table Notes:

1. Measurement locations are established on a triangular grid with randomly selected starting coordinates.
2. Measurement values are in units of dpm/100-cm^2.
3. Unless otherwise noted, all sample measurements are located by taking the lowest left-hand corner, of the surface on which they rest, as the origin. For example, the location of SM-1 is measured from the south west corner of the Sump Room (Room 6). In the map shown above, the sump walls are "unfolded" and represented as rectangles. To locate SM-3, the upper left corner represents true north. From this point, measure clockwise 1.82 meters; then measure 0.34 meters from the floor elevation down the side of the sump.

Survey Unit RO-3-6

ROLB Basement Class 1 Survey Unit, Sump Room, Men's Room & Janitor Closet - Lower Walls

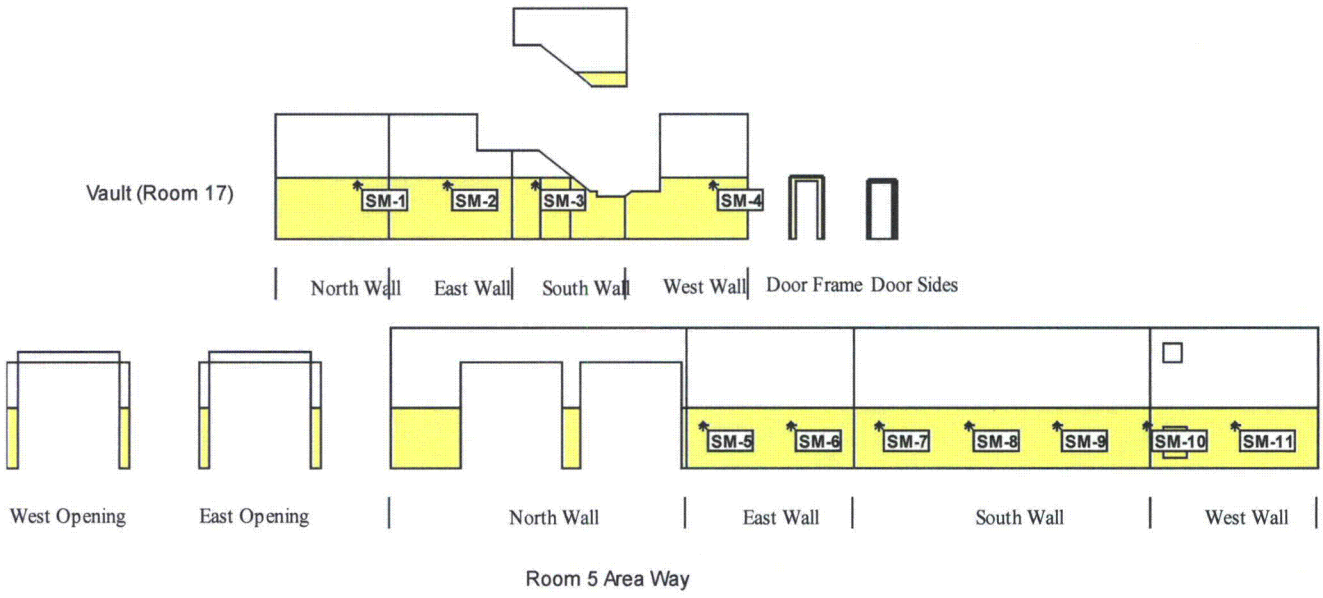
Survey Unit RO-3-6: ROLB Basement, Lower Walls, Class 1					
X Co-ord (m)	Y Co-ord (m)	Label	Value	Type	Notes
1.66	0.36	SM-1	129	Systematic	South wall, Room 6
1.00	0.36	SM-2	540	Systematic	West wall, Room 6
5.04	0.36	SM-3	395	Systematic	West wall, Room 6
9.08	0.36	SM-4	290	Systematic	West wall, Room 6
2.58	0.36	SM-5	194	Systematic	North wall, Room 6
1.94	0.36	SM-6	355	Systematic	East wall, Room 6
5.99	0.36	SM-7	339	Systematic	East wall, Room 6
10.03	0.36	SM-8	121	Systematic	East wall, Room 6
1.37	1.22	SM-9	1331	Systematic	East wall, Room 9
2.37	1.22	SM-10	121	Systematic	South wall, Room 9
0.90	1.85	SM-11	169	Systematic	East wall, Room 10

Table Notes:

1. Measurement locations are established on a triangular grid with randomly selected starting coordinates.
2. Measurement values are in units of dpm/100-cm^2.
3. Unless otherwise noted, all sample measurements are located by taking the lowest left-hand corner, of the surface on which they rest, as the origin. For example, the location of SM-1 is measured from the south east corner of the Sump Room (Room 6).

Survey Unit RO-3-7

ROLB Basement Class 1 Survey Unit, Area Way and Vault Lower Walls



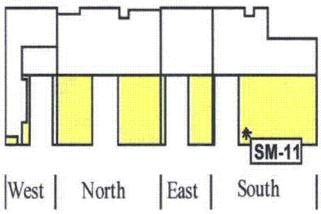
Survey Unit RO-3-7: ROLB Basement Area Way & Vault (lower walls) Class 1					
X Co-ord (m)	Y Co-ord (m)	Label	Value	Type	Notes
2.92	1.90	SM-1	599	Systematic	Vault, North Wall
2.08	1.90	SM-2	967	Systematic	Vault, East Wall
0.84	1.90	SM-3	703	Systematic	Vault, South Wall
3.17	1.90	SM-4	1375	Systematic	Vault, West Wall
0.62	1.51	SM-5	835	Systematic	Area Way, East Wall
3.80	1.51	SM-6	282	Systematic	Area Way, East Wall
0.97	1.51	SM-7	769	Systematic	Area Way, South Wall
4.15	1.51	SM-8	1177	Systematic	Area Way, South Wall
7.32	1.51	SM-9	1013	Systematic	Area Way, South Wall
10.50	1.51	SM-10	368	Systematic	Area Way, South Wall
3.07	1.51	SM-11	480	Systematic	Area Way, West Wall

Table Notes:

1. Measurement locations are established on a triangular grid with randomly selected starting coordinates.
2. Measurement values are in units of dpm/100-cm^2.
3. All static measurement sample points are located by taking the lowest left-hand corner, of the surface on which they rest, as the origin. For example, the location of SM-1 is measured from the northwest corner of the Vault (Room 17).

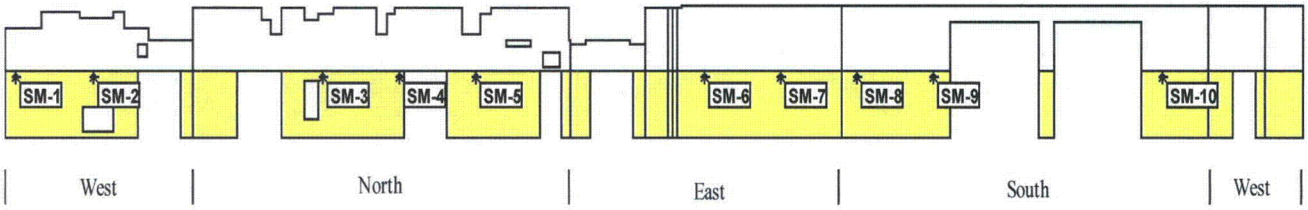
Survey Unit RO-3-8

ROLB Basement Class 1 Survey Unit, Cold Test Area and Vestibule Lower Walls



Vestibule

Cold Test Area

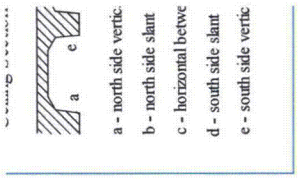


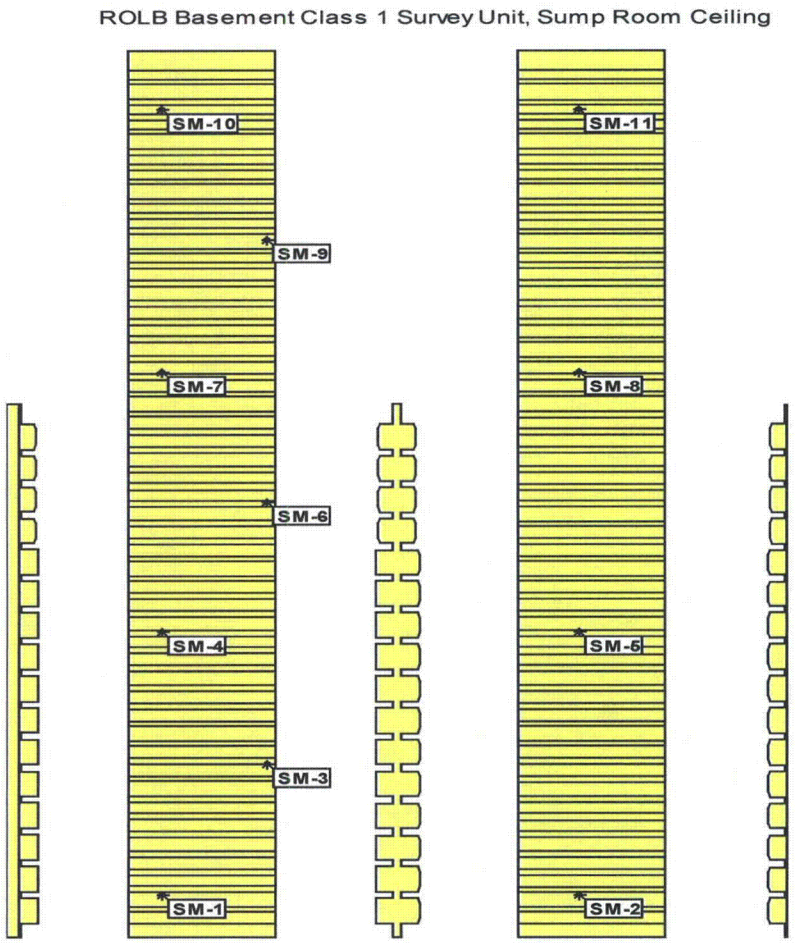
Survey Unit RO-3-8: ROLB Basement Cold Test Area & Vestibule (lower walls),Class 1					
X Co-ord (m)	Y Co-ord (m)	Label	Value	Type	Notes
0.51	1.90	SM-1	120	Systematic	West Wall – Room 4
3.69	1.90	SM-2	407	Systematic	
5.43	1.90	SM-3	472	Systematic	North Wall – Rom 4
8.61	1.90	SM-4	213	Systematic	
11.79	1.90	SM-5	167	Systematic	
1.15	1.90	SM-6	306	Systematic	East Wall measured from south side of Column B5
4.33	1.90	SM-7	19	Systematic	
0.68	1.90	SM-8	93	Systematic	South Wall – Room 4
3.86	1.90	SM-9	296	Systematic	
13.39	1.90	SM-10	694	Systematic	
1.46	0.29	SM-11	432	Systematic	South Wall – Room 8

Table Notes:

1. Measurement locations are established on a triangular grid with randomly selected starting coordinates.
2. Measurement values are in units of dpm/100-cm^2.
3. Unless otherwise noted, all sample measurements are located by taking the lowest left-hand corner, of the surface on which they rest, as the origin. For example, the location of SM-6 is measured from the south side of Column B5 on the East Wall of the Cold Test Area (Room 4).

Survey Unit RO-3-9





Survey Unit RO-3-9: ROLB Basement, Sump Room (ceiling), Class 1					
X Co-ord (m)	Y Co-ord (m)	Label	Value	Type	Notes
0.50	See Note 3	SM-1	621	Systematic	Between beams 1 and 2 on the horizontal surface
0.92	See Note 3	SM-2	636	Systematic	
2.01	See Note 3	SM-3	523	Systematic	Beam 4, horizontal surface
0.50	See Note 3	SM-4	371	Systematic	Beam 6, north slanted surface
0.92	See Note 3	SM-5	273	Systematic	
2.01	See Note 3	SM-6	508	Systematic	Beam 9, south slanted surface
0.50	See Note 3	SM-7	394	Systematic	Beam 11, north vertical surface
0.92	See Note 3	SM-8	356	Systematic	
2.01	See Note 3	SM-9	659	Systematic	Between beams 13 and 14 on the horizontal surface
0.50	See Note 3	SM-10	295	Systematic	Beam 16, north vertical surface
0.92	See Note 3	SM-11	538	Systematic	

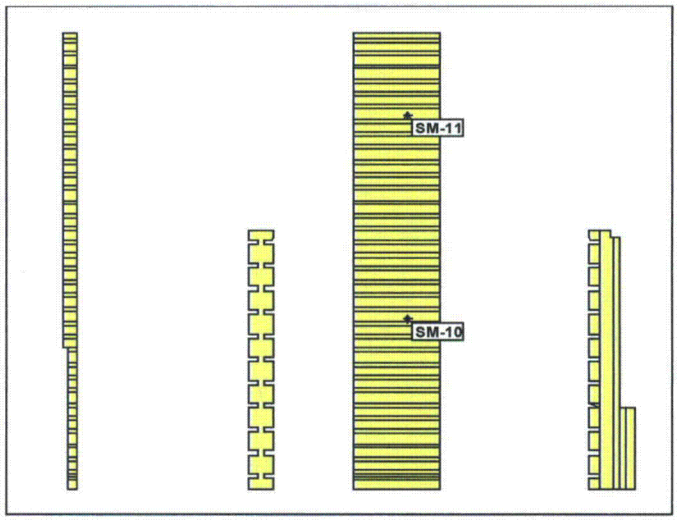
Table Notes:

1. Measurement locations are established on a triangular grid with randomly selected starting coordinates.
2. Measurement values are in units of dpm/100-cm^2.
3. In lieu of y-coordinates, beam numbers are provided for SM-1 through SM-11. Lateral or transverse beams have been marked in the field to aid in their being located. Use the Ceiling Section (provided on the map) as a guide to locating the correct portion of the transverse beam to survey.

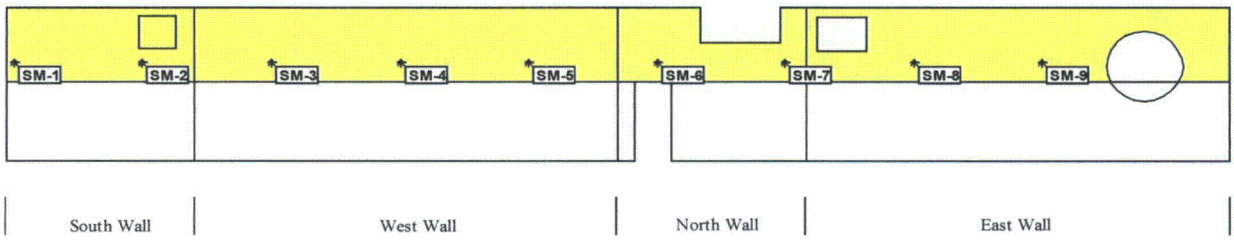
Survey Unit RO-3-10

ROLB Basement Class 1 Survey Unit

Vestibule, Men's Room, Janitor Ceiling →



Sump Room Upper Walls



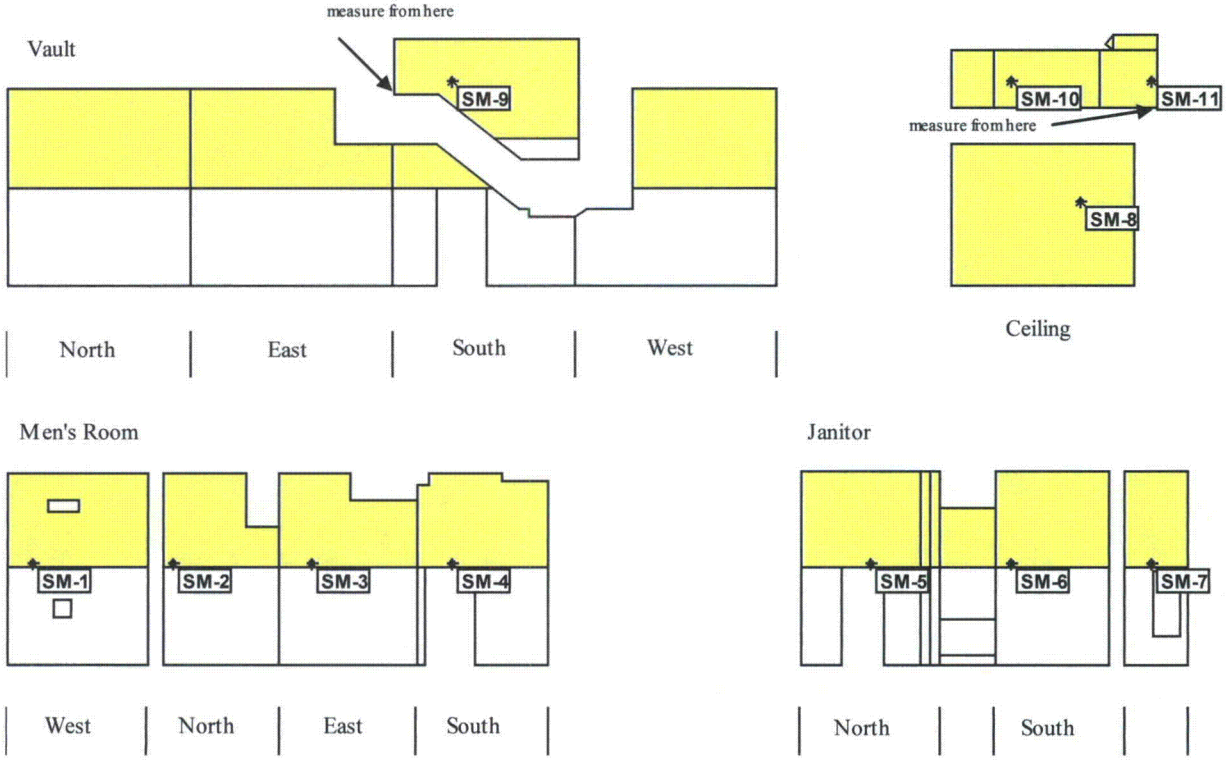
Survey Unit RO-3-10: ROLB Basement (ceilings), Class 1					
X Co-ord (m)	Y Co-ord (m)	Label		Type	Notes
0.22	2.67	SM-1	264	Systematic	Sump Room, South Wall
3.42	2.67	SM-2	306	Systematic	
1.92	2.67	SM-3	368	Systematic	Sump Room, West Wall
5.12	2.67	SM-4	-56	Systematic	
8.32	2.67	SM-5	313	Systematic	
1.00	2.67	SM-6	257	Systematic	Sump Room, North Wall
4.20	2.67	SM-7	160	Systematic	
2.70	2.67	SM-8	222	Systematic	Sump Room, East Wall
5.91	2.67	SM-9	222	Systematic	
1.35	N/A	SM-10	597	Systematic	Between beams 21 and 22 on horizontal surface
1.35	N/A	SM-11	457	Systematic	Between beams 26 and 27 on horizontal surface

Table Notes:

1. Measurement locations are established on a triangular grid with randomly selected starting coordinates.
2. Measurement values are in units of dpm/100-cm^2.
3. Unless otherwise noted, all sample measurements are located by taking the lowest left-hand corner, of the surface on which they rest, as the origin. For example, the location of SM-6 is measured from the north west corner in the Sump Room (Room 6). In lieu of y-coordinates, beam numbers are provided for both SM-10 and SM-11. Lateral or transverse beams have been marked in the field to aid in their being located.

Survey Unit RO-3-11

ROLB Basement Class 1 Survey Unit, Men's Room, Janitor Closet and Vault Upper Walls & Vault Ceiling



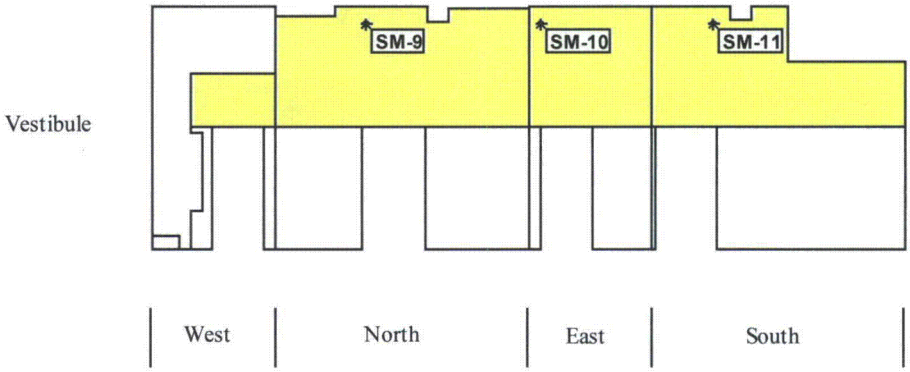
Survey Unit RO-3-11: ROLB Basement (ceilings), Class 1					
X Co-ord (m)	Y Co-ord (m)	Label	Value	Type	Notes
0.57	2.22	SM-1	651	Systematic	Men's Room West Wall
0.55	2.22	SM-2	230	Systematic	Men's Room North Wall
0.75	2.22	SM-3	1559	Systematic	Men's Room East Wall
0.78	2.22	SM-4	1341	Systematic	Men's Room South Wall
1.55	2.22	SM-5	342	Systematic	Janitor North Wall
0.35	2.22	SM-6	98	Systematic	Janitor South Wall
0.60	2.22	SM-7	315	Systematic	Janitor West Wall
2.86	1.84	SM-8	1059	Systematic	Vault Ceiling
1.25	0.27	SM-9	782	Systematic	Vault Upper Wall
0.40	0.57	SM-10	703	Systematic	Vault Ceiling
-0.12	0.57	SM-11	381	Systematic	Vault Ceiling

Table Notes:

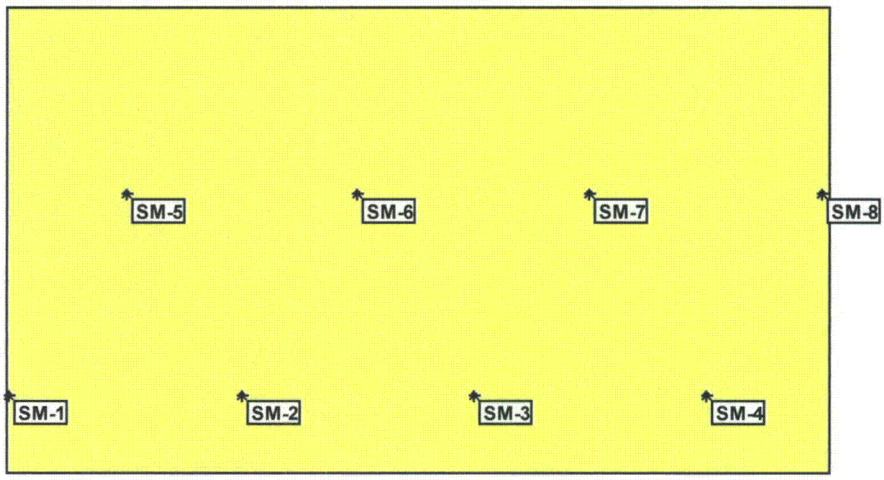
1. Measurement locations are established on a triangular grid with randomly selected starting coordinates.
2. Measurement values are in units of dpm/100-cm^2.
3. Unless otherwise noted, all sample measurements are located by taking the lowest left-hand corner, of the surface on which they rest, as the origin. For example, the location of SM-11 is measured from the south side, against the east wall of the Vault Ceiling.

Survey Unit RO-3-12

ROLB Basement Class 1 Survey Unit, Vestibule Upper Walls & Area Way Ceiling



Area Way Ceiling



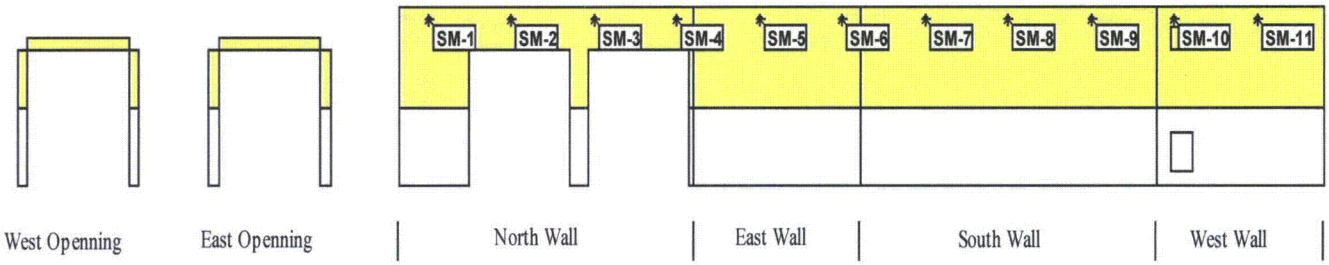
Survey Unit RO-3-12: ROLB Basement, Class 1					
X Co-ord (m)	Y Co-ord (m)	Label	Value	Type	Notes
0.06	1.00	SM-1	-43	Systematic	Area Way Ceiling
3.05	1.00	SM-2	268	Systematic	
6.04	1.00	SM-3	239	Systematic	
9.03	1.00	SM-4	-399	Systematic	
1.56	3.59	SM-5	-167	Systematic	
4.55	3.59	SM-6	174	Systematic	
7.54	3.59	SM-7	-174	Systematic	
10.53	3.59	SM-8	72	Systematic	
1.56	1.76	SM-9	232	Systematic	Vestibule North Wall
0.23	1.76	SM-10	420	Systematic	Vestibule East Wall
1.06	1.76	SM-11	659	Systematic	Vestibule South Wall

Table Notes:

1. Measurement locations are established on a triangular grid with randomly selected starting coordinates.
2. Measurement values are in units of dpm/100-cm^2.
3. Unless otherwise noted, all sample measurements are located by taking the lowest left-hand corner, of the surface on which they rest, as the origin. For example, the location of SM-1 is measured from the south west corner of the Area Way Ceiling.

Survey Unit RO-3-13

ROLB Basement Class 1 Survey Unit, Area Way Upper Walls

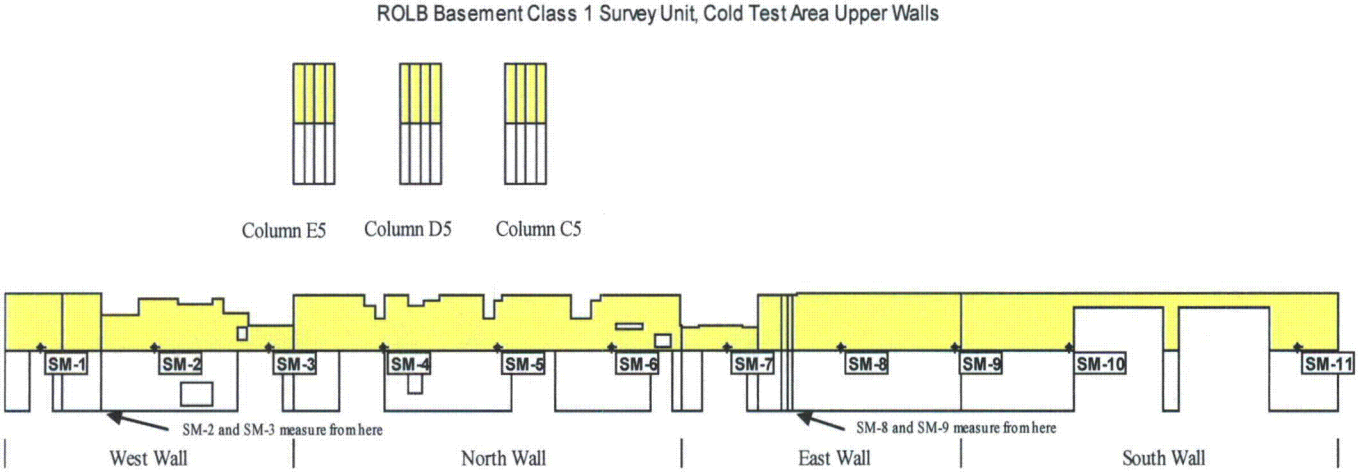


Survey Unit RO-3-13: ROLB Basement, Area Way (upper walls), Class 1					
X Co-ord (m)	Y Co-ord (m)	Label	Value	Type	Notes
1.07	4.52	SM-1	629	Systematic	North Wall
4.05	4.52	SM-2	766	Systematic	
7.03	4.52	SM-3	887	Systematic	
10.01	4.52	SM-4	427	Systematic	
2.40	4.52	SM-5	500	Systematic	East Wall
5.38	4.52	SM-6	774	Systematic	
2.33	4.52	SM-7	605	Systematic	South Wall
5.31	4.52	SM-8	806	Systematic	
8.29	4.52	SM-9	508	Systematic	
0.66	4.52	SM-10	476	Systematic	West Wall
3.64	4.52	SM-11	266	Systematic	

Table Notes:

1. Measurement locations are established on a triangular grid with randomly selected starting coordinates.
2. Measurement values are in units of dpm/100-cm^2.
3. Unless otherwise noted, all sample measurements are located by taking the lowest left-hand corner, of the surface on which they rest, as the origin. For example, the location of SM-7 is measured from the south east corner of the Area Way.

Survey Unit RO-3-14

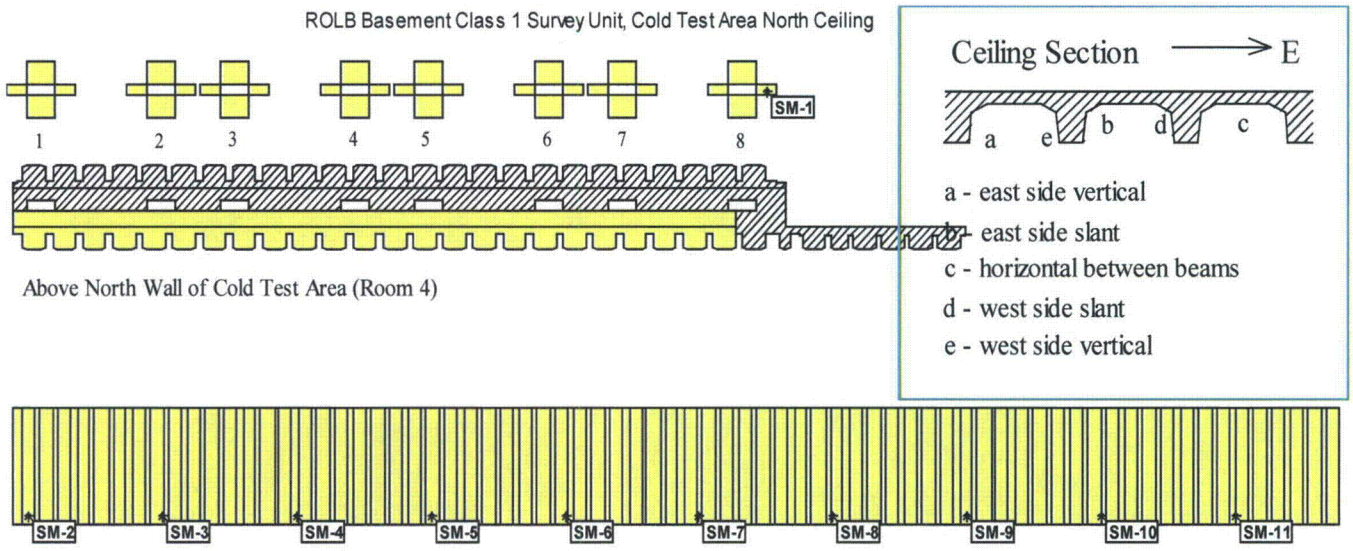


Survey Unit RO-3-14: ROLB Basement, Cold Test Area & Columns (upper walls), Class 1					
X Co-ord (m)	Y Co-ord (m)	Label	Value	Type	Notes
1.45	2.29	SM-1	121	Systematic	West Wall
2.105	2.29	SM-2	-8	Systematic	
6.78	2.29	SM-3	274	Systematic	
3.60	2.29	SM-4	113	Systematic	North Wall
8.23	2.29	SM-5	234	Systematic	
12.85	2.29	SM-6	32	Systematic	
1.81	2.29	SM-7	210	Systematic	East Wall
1.96	2.29	SM-8	-105	Systematic	East Wall – measured from south side of column B5
6.58	2.29	SM-9	153	Systematic	
4.37	2.29	SM-10	-113	Systematic	South Wall
13.61	2.29	SM-11	435	Systematic	

Table Notes:

1. Measurement locations are established on a triangular grid with randomly selected starting coordinates.
2. Measurement values are in units of dpm/100-cm^2.
3. Unless otherwise noted, all sample measurements are located by taking the lowest left-hand corner, of the surface on which they rest, as the origin. For example, the location of SM-1 is measured from the southwest corner of the Cold Test Area (Room 4).

Survey Unit RO-3-15

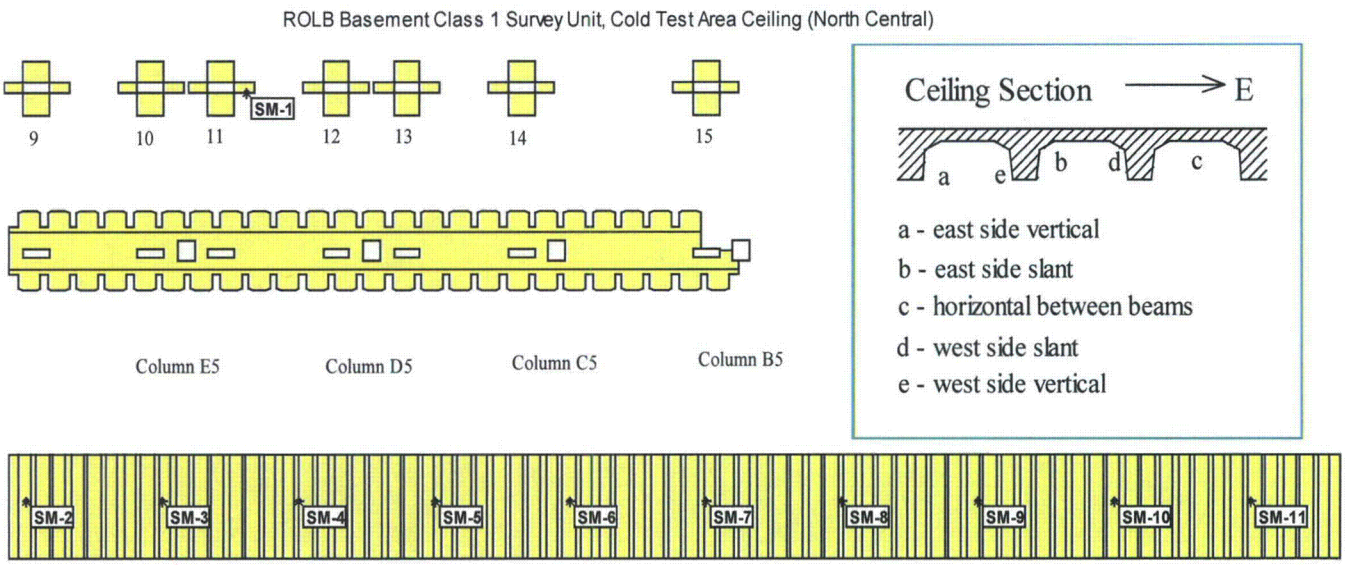


Survey Unit RO-3-15: ROLB Basement Cold Test Area, North (ceiling), Class 1					
X Co-ord (m)	Y Co-ord (m)	Label	Value	Type	Notes
-0.12	-0.19	SM-1	690	Systematic	See below
N/A	0.15	SM-2	460	Systematic	Beam 1, east vertical
N/A	0.15	SM-3	526	Systematic	Between beams 3 and 4, horizontal surface
N/A	0.15	SM-4	460	Systematic	Beam 6,horizontal surface
N/A	0.15	SM-5	302	Systematic	Between beams 8 and 9, horizontal surface
N/A	0.15	SM-6	457	Systematic	Beam 11, west vertical
N/A	0.15	SM-7	513	Systematic	Beam 13, east slant
N/A	0.15	SM-8	394	Systematic	Beam 16, west vertical
N/A	0.15	SM-9	328	Systematic	Beam 18, east vertical
N/A	0.15	SM-10	657	Systematic	Beam 21, west slant
N/A	0.15	SM-11	144	Systematic	Beam 23, horizontal surface

Table Notes:

1. Measurement locations are established on a triangular grid with randomly selected starting coordinates.
2. Measurement values are in units of dpm/100-cm^2.
3. The location of SM-1 is measured 0.12m north off the 1st floor hallway, then down the floor opening 0.19 m. This measurement location is just above the highest point of the ceiling in the Cold Test Area (Room 4).
4. For the remainder of the static measurements, in lieu of x-coordinates, beam numbers are provided. Beams have been marked in the field to aid in locating them. Use the Ceiling Section (provided on the map) as a guide to locating the correct portion of the beam to survey. All static measurements are taken from the south end of the beam.

Survey Unit RO-3-16



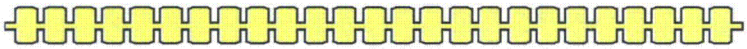
Survey Unit RO-3-16: ROLB Basement, Cold Test Area, North Central (ceiling), Class 1					
X Co-ord (m)	**Y Co-ord (m)**	**Label**	**Type**	**Value**	**Notes**
-0.19	-0.17	SM-1	Systematic	308	Note 3
N/A	-1.00	SM-2	Systematic	476	Beam 1, east vertical
N/A	-1.00	SM-3	Systematic	347	Beam 4, west vertical
N/A	-1.00	SM-4	Systematic	613	Beam 6, east slant
N/A	-1.00	SM-5	Systematic	274	Beam 9, horizontal surface
N/A	-1.00	SM-6	Systematic	379	Between beams 11 and 12, horizontal surface
N/A	-1.00	SM-7	Systematic	508	Beam 14, east vertical
N/A	-1.00	SM-8	Systematic	460	Beam 17, west slant
N/A	-1.00	SM-9	Systematic	476	Beam 19, east vertical
N/A	-1.00	SM-10	Systematic	540	Beam 22, west vertical
N/A	-1.00	SM-11	Systematic	524	Between beams 24 and 25, horizontal surface

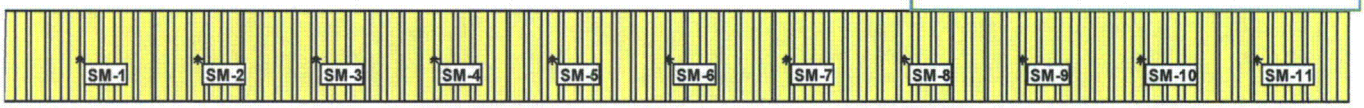
Table Notes:

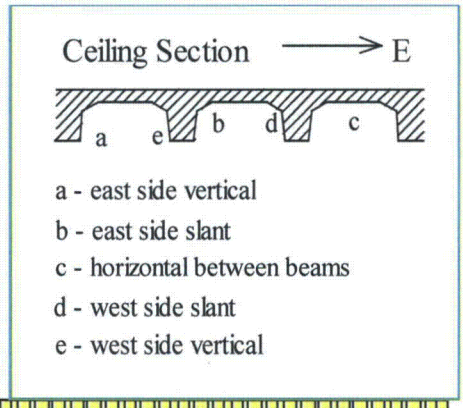
1. Measurement locations are established on a triangular grid with randomly selected starting coordinates.
2. Measurement values are in units of dpm/100-cm^2.
3. SM-1 is measured 0.19 meters south off the 1st floor hallway, then down into the opening 0.17 meters. For the remainder of the static measurements, beam numbers are provided in lieu of x-coordinates. Beams have been marked in the field to aid in locating them. Use the Ceiling Section (provided on the map) as a guide to locating measurement points. All static measurements are taken 1.00 meters from the north end of the beam.

Survey Unit RO-3-17

ROLB Basement Class 1 Survey Unit, Cold Test Area (South Central) Ceiling







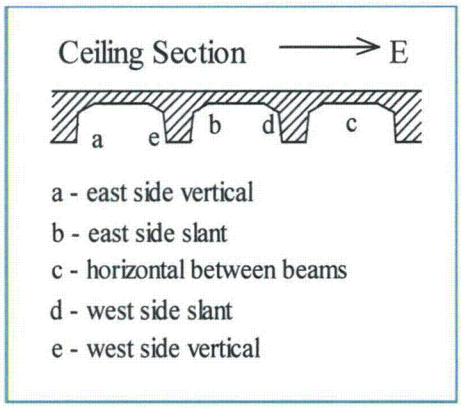
Survey Unit RO-3-17: ROLB Basement Cold Test Area, South Central (ceiling), Class 1					
X Co-ord (m)	**Y Co-ord (m)**	**Label**	**Value**	**Type**	**Notes**
Note 3	0.90	SM-1	484	Systematic	Beam 2, east slant
Note 3	0.90	SM-2	565	Systematic	Between beams 4 and 5, horizontal surface
Note 3	0.90	SM-3	468	Systematic	Beam 7, west vertical
Note 3	0.90	SM-4	306	Systematic	Beam 9, horizontal surface
Note 3	0.90	SM-5	581	Systematic	Beam 11, east vertical
Note 3	0.90	SM-6	194	Systematic	Between beams 13 and 14, horizontal surface
Note 3	0.90	SM-7	508	Systematic	Between beams 15 and 16, horizontal surface
Note 3	0.90	SM-8	339	Systematic	Beam 18, west vertical
Note 3	0.90	SM-9	234	Systematic	Beam 20, horizontal surface
Note 3	0.90	SM-10	226	Systematic	Beam 22, east vertical
Note 3	0.90	SM-11	645	Systematic	Between beams 24 and 25, horizontal surface

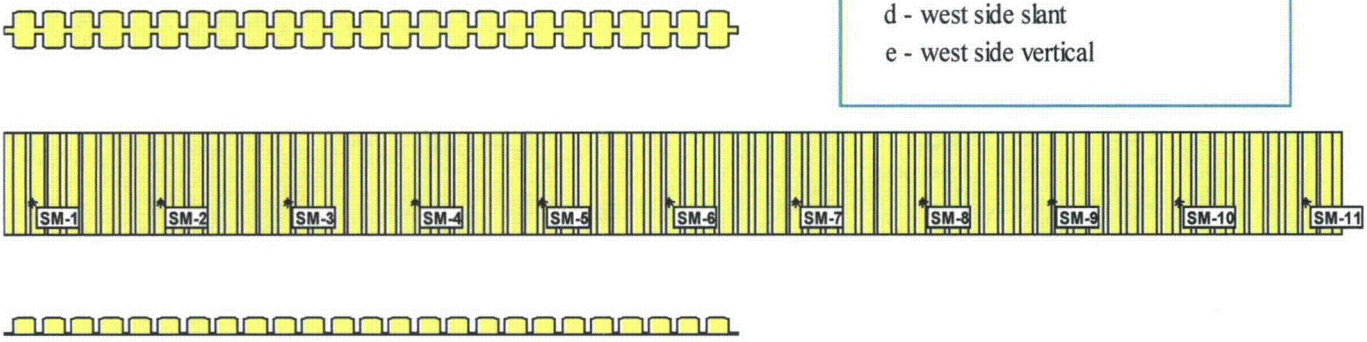
Table Notes:

1. Measurement locations are established on a triangular grid with randomly selected starting coordinates
2. Measurement values are in units of dpm/100-cm^2.
3. Beam numbers are provided for SM-1 through SM-11 In lieu of x-coordinates. Lateral or transverse beams have been marked in the field to aid in locating them. The Ceiling Section (on the map) is provided as an aid in locating the measurement points. All SM-1 through SM-11 static points are 0.90 meters north from the south end of the smaller, north/south, lateral or transverse ceiling beams.

Survey Unit RO-3-18

ROLB Basement Class 1 Survey Unit, Cold Test Area Ceiling (South)





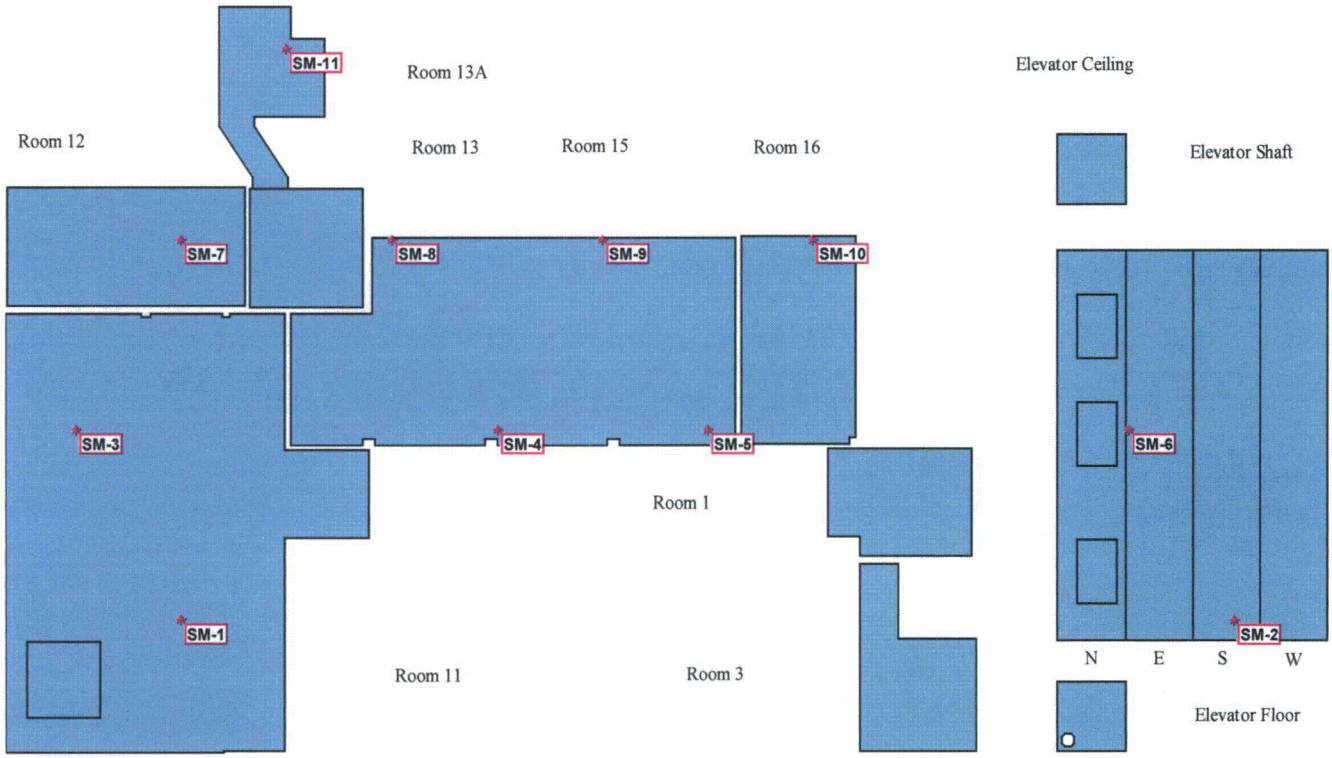
Survey Unit RO-3-18: ROLB Basement, Cold Test Area, South (ceiling), Class 1					
X Co-ord (m)	Y Co-ord (m)	Label	Value	Type	Notes
See Note 3	0.67	SM-1	419	Systematic	Between beams 1 and 2, horizontal surface
See Note 3	0.67	SM-2	234	Systematic	Beam 4, west vertical surface
See Note 3	0.67	SM-3	452	Systematic	Beam 6, east vertical surface
See Note 3	0.67	SM-4	524	Systematic	Between beams 8 and 9, horizontal surface
See Note 3	0.67	SM-5	282	Systematic	Beam 11, horizontal surface
See Note 3	0.67	SM-6	452	Systematic	Between beams 13 and 14, horizontal surface
See Note 3	0.67	SM-7	573	Systematic	Beam 16, west vertical surface
See Note 3	0.67	SM-8	234	Systematic	Beam 18, east vertical surface
See Note 3	0.67	SM-9	0	Systematic	Between beams 20 and 21, horizontal surface
See Note 3	0.67	SM-10	169	Systematic	Beam 23 horizontal surface
See Note 3	0.67	SM-11	444	Systematic	Between beam 25 and the Elevator Machinery west wall, horizontal surface

Table Notes:

1. Measurement locations are established on a triangular grid with randomly selected starting coordinates.
2. Measurement values are in units of dpm/100-cm^2.
3. In lieu of x-coordinates, beam numbers are provided for SM-1 through SM-11. Lateral or transverse beams have been marked in the field to aid in locating them. A diagram of the Ceiling Section is shown on the map as a guide to locating measurement points. All SM-1 through SM-11 static points are 0.67 meters north from the south end of the smaller, north/south, lateral or transverse ceiling beams.

Survey Unit RO-3-25

ROLB Basement Class 2 Survey Unit, Designated Floors, Elevator Shaft Walls and Ceiling



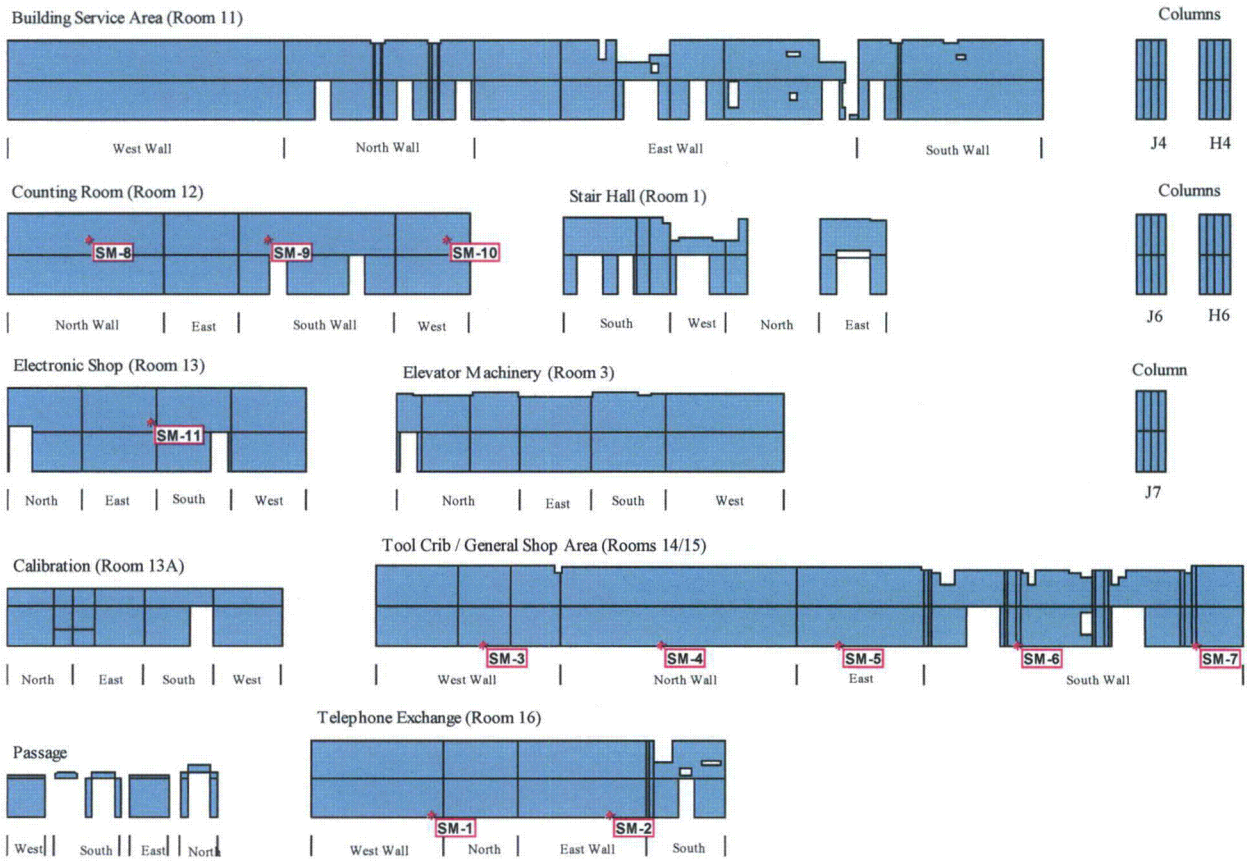
Survey Unit RO-3-25: ROLB Basement, Designated Areas (floors, walls & ceilings), Class 2					
X Co-ord (m)	Y Co-ord (m)	Label	Value	Type	Notes
6.06	4.50	SM-1	768	Systematic	N/A
1.43	0.68	SM-2	523	Systematic	N/A
2.37	10.89	SM-3	442	Systematic	N/A
7.15	0.56	SM-4	790	Systematic	N/A
14.53	0.56	SM-5	536	Systematic	N/A
0.10	1.27	SM-6	411	Systematic	On the east wall, 0.10m south of the north wall, 1.72m above a line parallel to the bottom of the elevator door
6.05	2.26	SM-7	362	Systematic	N/A
3.47	6.95	SM-8	819	Systematic	N/A
10.84	6.95	SM-9	891	Systematic	N/A
2.48	6.95	SM-10	862	Systematic	N/A
2.29	-1.39	SM-11	652	Systematic	Measured from the northwest corner of Calibration Room13A

Table Notes:

1. Measurement locations are established on a triangular grid with randomly selected starting coordinates.
2. Measurement values are in units of dpm/100-cm^2.
3. All of the sample measurements are located by taking the lowest left-hand corner, of the surface on which they rest, as the origin. For example, the location of SM-1 is measured from the south west corner of the Building Service Area (Room 11).

Survey Unit RO-3-26

ROLB Basement Class 2 Survey Unit, Lower & Upper Walls of Designated Roooms



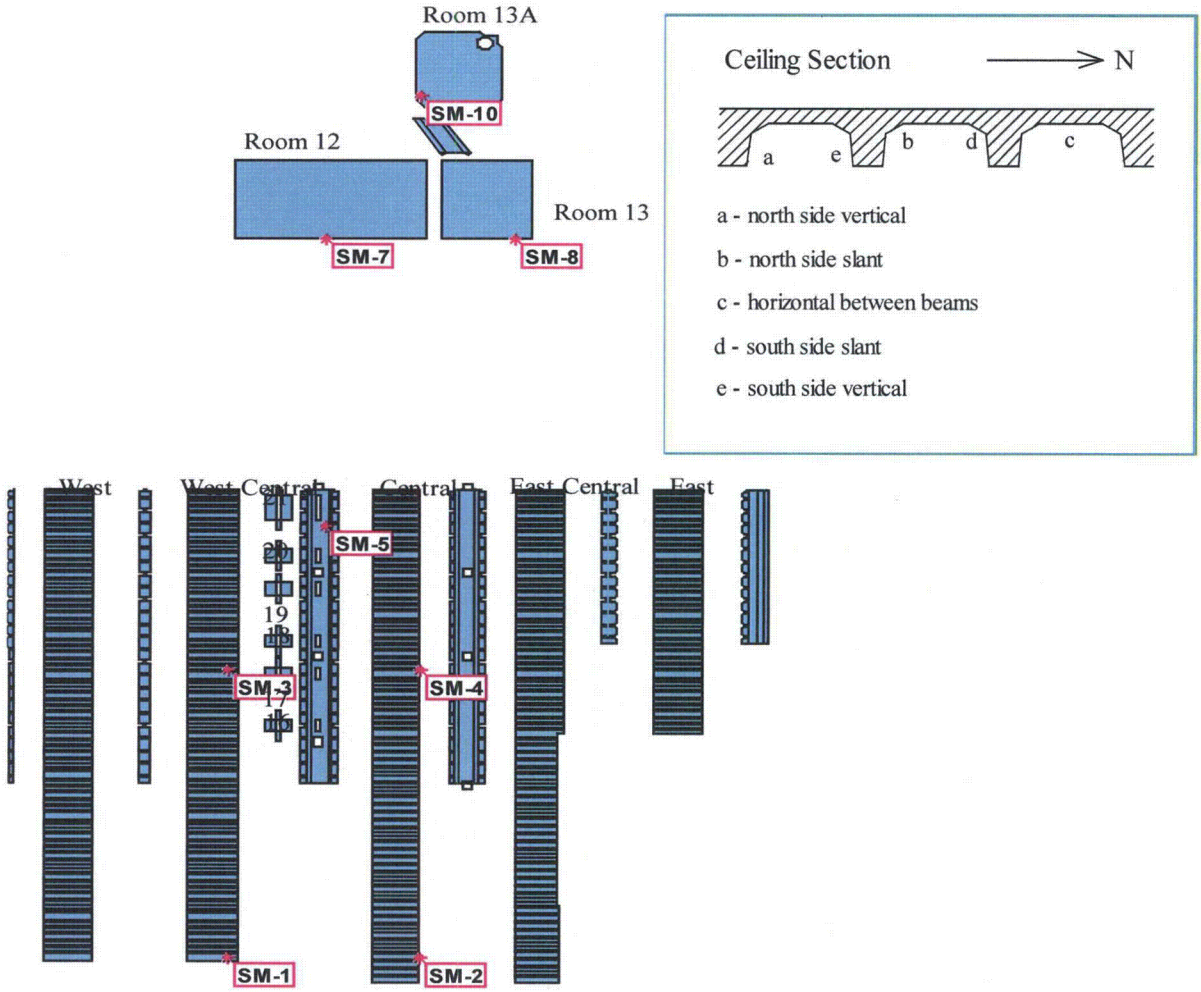
Survey Unit RO-3-26: ROLB Basement, Designated Areas (lower & upper walls), Class 2					
X Co-ord (m)	Y Co-ord (m)	Label	Value	Type	Notes
6.31	0.21	SM-1	70	Systematic	Room 16, west wall
4.78	0.21	SM-2	310	Systematic	Room 16, east wall
1.27	0.12	SM-3	620	Systematic	Rm. 14/15, west wall
5.38	0.12	SM-4	113	Systematic	Rm. 14/15, north wall
2.22	0.12	SM-5	-77	Systematic	Rm. 14/15, east wall
0.06	0.12	SM-6	85	Systematic	West side of column D4
0.20	0.12	SM-7	352	Systematic	West side of column F4
4.30	3.01	SM-8	859	Systematic	Room 12, north wall
1.51	3.01	SM-9	500	Systematic	Room 12, south wall
2.72	3.01	SM-10	908	Systematic	Room 12, west wall
3.59	2.66	SM-11	831	Systematic	Room 13, east wall

Table Notes:

1. Measurement locations are established on a triangular grid with randomly selected starting coordinates.
2. Measurement values are in units of dpm/100-cm^2.
3. All of the sample measurements are located by taking the lowest left-hand corner, of the surface on which they rest, as the origin. For example, the location of SM-1 is measured from the southwest corner of the Telephone Exchange (Room 16).

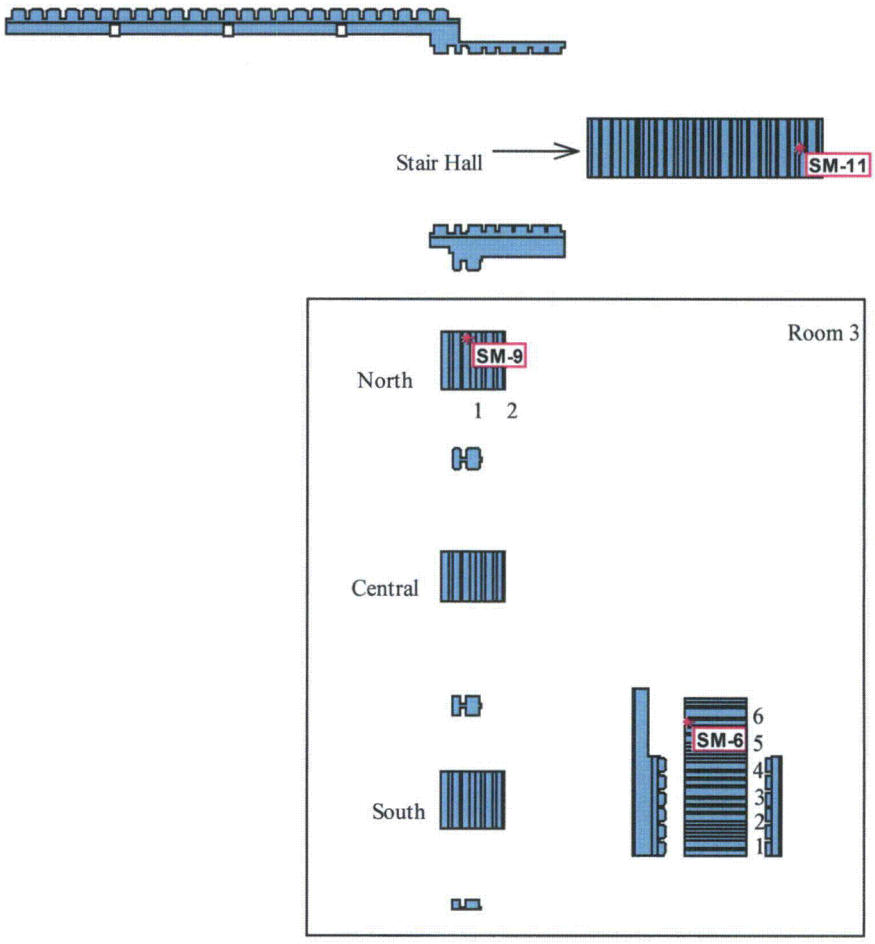
Survey Unit RO-3-27
(Page 1 of 3)

ROLB Basement Class 2 Survey Unit, Rooms 11-13A, Ceilings



Survey Unit RO-3-27
(Page 2 of 3)

ROLB Basement Class 2 Survey Unit, Rooms 15, 16 Ceilings



Survey Unit RO-3-27
(Page 3 of 3)

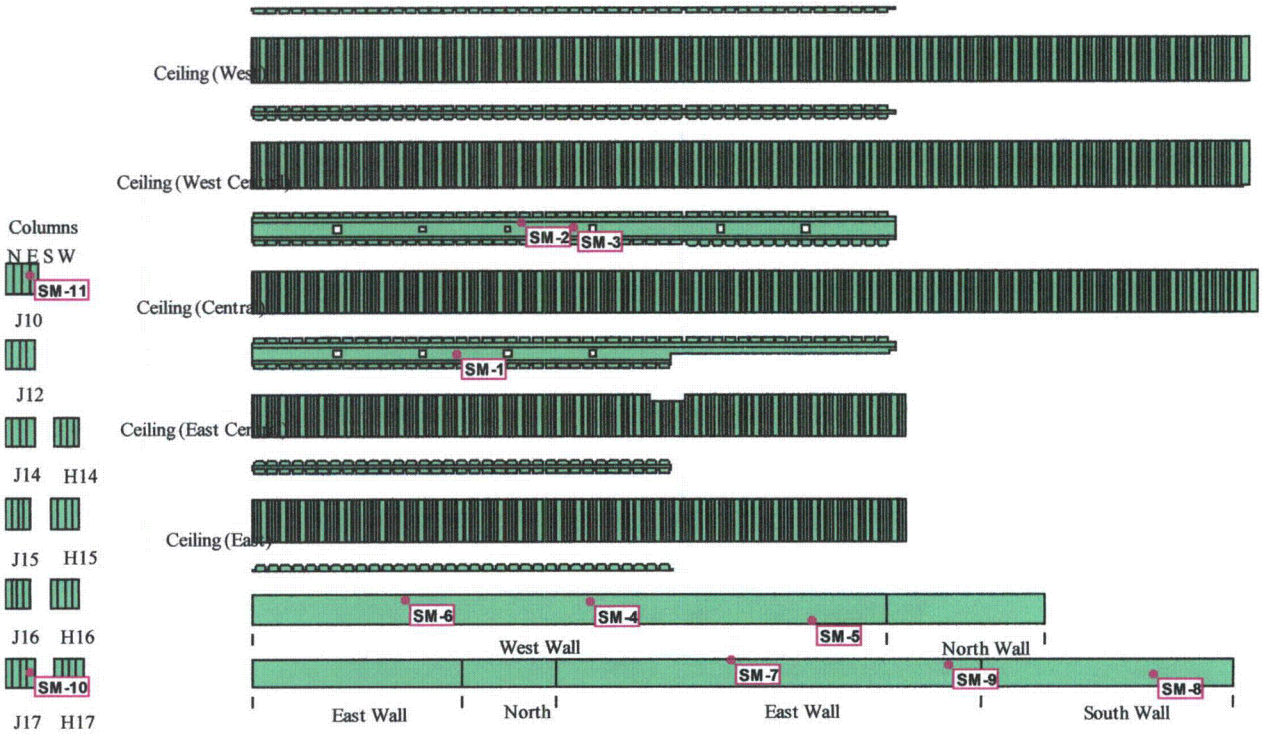
Survey Unit RO-3-27: ROLB Basement, Room 15, 16 (ceilings), Class 2					
X Co-ord (m)	Y Co-ord (m)	Label	Value	Type	Notes
1.76	0.13	SM-1	915	Systematic	Just above the south wall
N/A	N/A	SM-2	437	Systematic	Between beams 18 & 19, against the east wall
1.76	N/A	SM-3	310	Systematic	Beam 32, south vertical
N/A	N/A	SM-4	500	Systematic	Beam 33, south slant, against the east wall
0.15	-0.28	SM-5	359	Systematic	Southeast of beam penetration 21
0.13	N/A	SM-6	641	Systematic	Beam 5, north vertical
3.87	0.08	SM-7	570	Systematic	N/A
3.19	0.08	SM-8	965	Systematic	N/A
N/A	-0.22	SM-9	394	Systematic	Beam 1, west vertical
0.20	0.16	SM-10	1099	Systematic	N/A
N/A	1.19	SM-11	437	Systematic	Beam 32, east vertical

Table Notes:

1. Measurement locations are established on a triangular grid with randomly selected starting coordinates.
2. Measurement values are in units of dpm/100-cm^2.
3. Unless otherwise noted, sample measurements are located by taking the lowest left-hand corner, of the surface on which they rest, as the origin. For example, the location of SM-7 is measured from the southwest corner of the Counting Room (Room 12).
4. In lieu of x-coordinates, beam numbers are provided for SM-2, SM-4, SM-9. and SM-11. Lateral or transverse beams have been marked in the field to aid in locating them. In lieu of y coordinates, beam numbers are provided for SM-2 through SM-4 and SM-6.The Ceiling Section (see the maps on page 66 and 67) is provided as a guide to locating the measurement points on the transverse ceiling beams.

Survey Unit RO-3-28A

ROLB Basement Class 3 Survey Unit, Crawl Space Walls and Ceiling

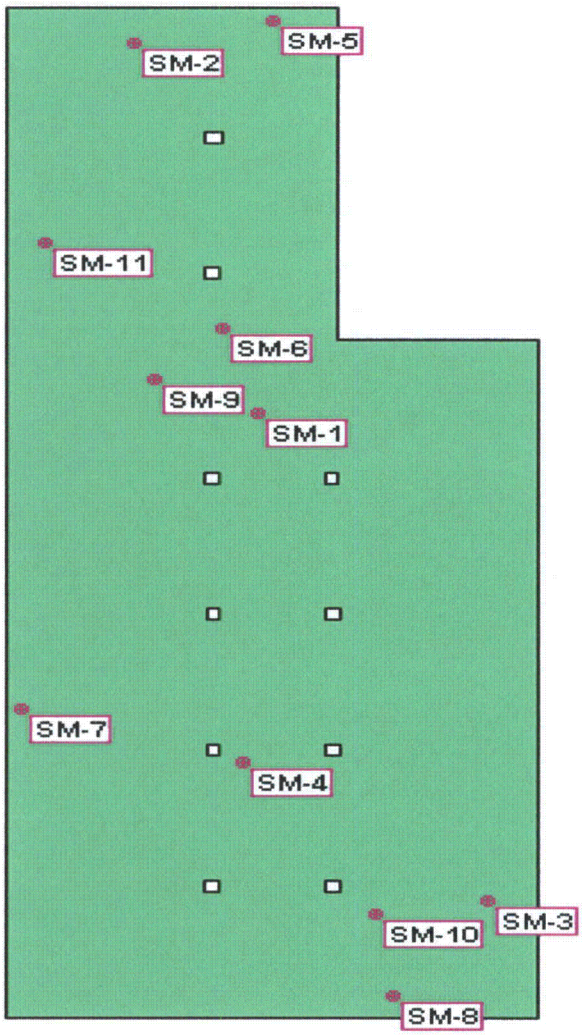


Survey Unit RO-3-28A: ROLB Basement Crawl Space (walls & ceiling), Class 3					
X Co-ord (m)	Y Co-ord (m)	Label	Value	Type	Notes
1.51	0.28	SM-1	472	Random	North from Column H16
0.52	0.77	SM-2	500	Random	North from Column J15
3.15	0.47	SM-3	549	Random	North from Column J15
16.89	-0.28	SM-4	908	Random	West Wall
27.98	-1.30	SM-5	1140	Random	
7.63	-0.21	SM-6	697	Random	
8.75	-0.03	SM-7	852	Random	East Wall
8.57	-0.77	SM-8	479	Random	South Wall
19.65	-0.25	SM-9	331	Random	East Wall
0.14	-0.68	SM-10	775	Random	West Side of Column J17
0.40	-0.54	SM-11	732	Random	South Side of Column J10

Table Notes:

1. Measurement locations are selected on a random basis – Class 3 survey unit.
2. Measurement values are in units of dpm/100-cm^2.
3. The y-coordinates of SM-4 through SM-11 are measured from the top of the wall or column because the floor is not consistently level.

Survey Unit RO-3-28B
ROLB Basement Class 3 Survey Unit, Crawl Space Soil

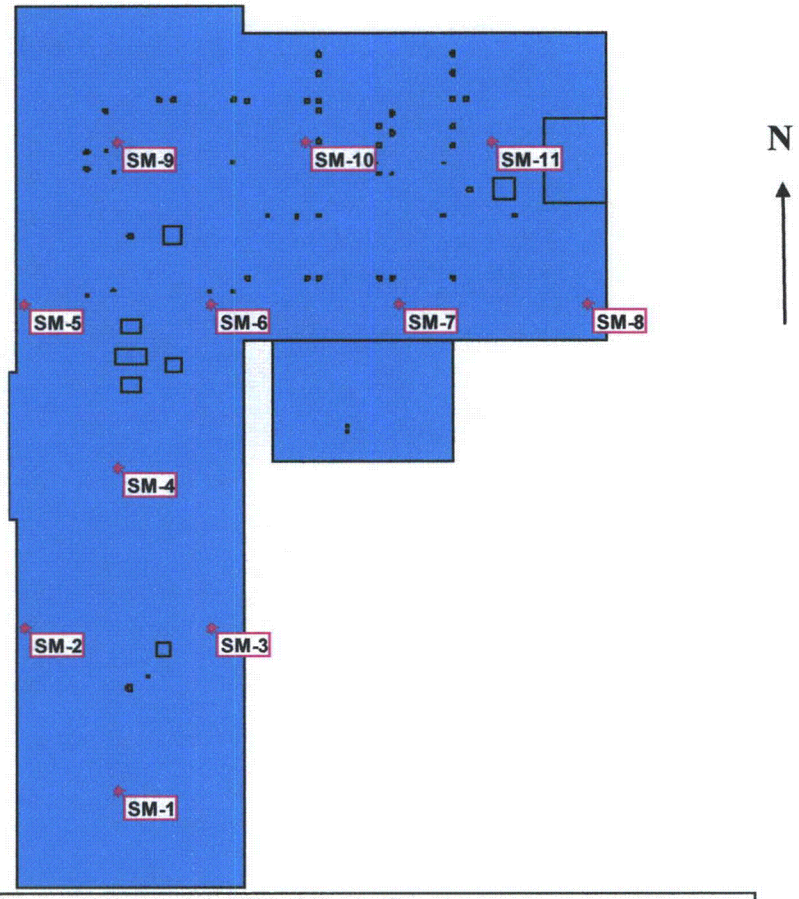


Survey Unit RO-3-28B: ROLB Basement Crawl Space (soil), Class 3					
X Co-ord (m)	Y Co-ord (m)	Label	Value	Type	Notes
5.93	19.01	SM-1	<MDA	Random	N/A
3.01	30.60	SM-2	<MDA	Random	N/A
11.39	3.67	SM-3	<MDA	Random	N/A
5.57	8.05	SM-4	0.118	Random	N/A
6.28	31.28	SM-5	<MDA	Random	N/A
5.11	21.63	SM-6	<MDA	Random	N/A
0.39	9.70	SM-7	<MDA	Random	N/A
9.15	0.68	SM-8	<MDA	Random	N/A
3.47	20.07	SM-9	<MDA	Random	N/A
8.74	3.30	SM-10	<MDA	Random	N/A
0.90	24.32	SM-11	<MDA	Random	N/A

Table Notes:
1. Measurement locations are selected on a random basis – Class 3 survey unit.
2. Measurement values are in units of pCi/g Cs-137.
3. All measurements are made from the extreme southwest corner of the crawl space.

Survey Unit RO-4-1

ROLB Exterior Class 2 Survey Unit, Building Roof



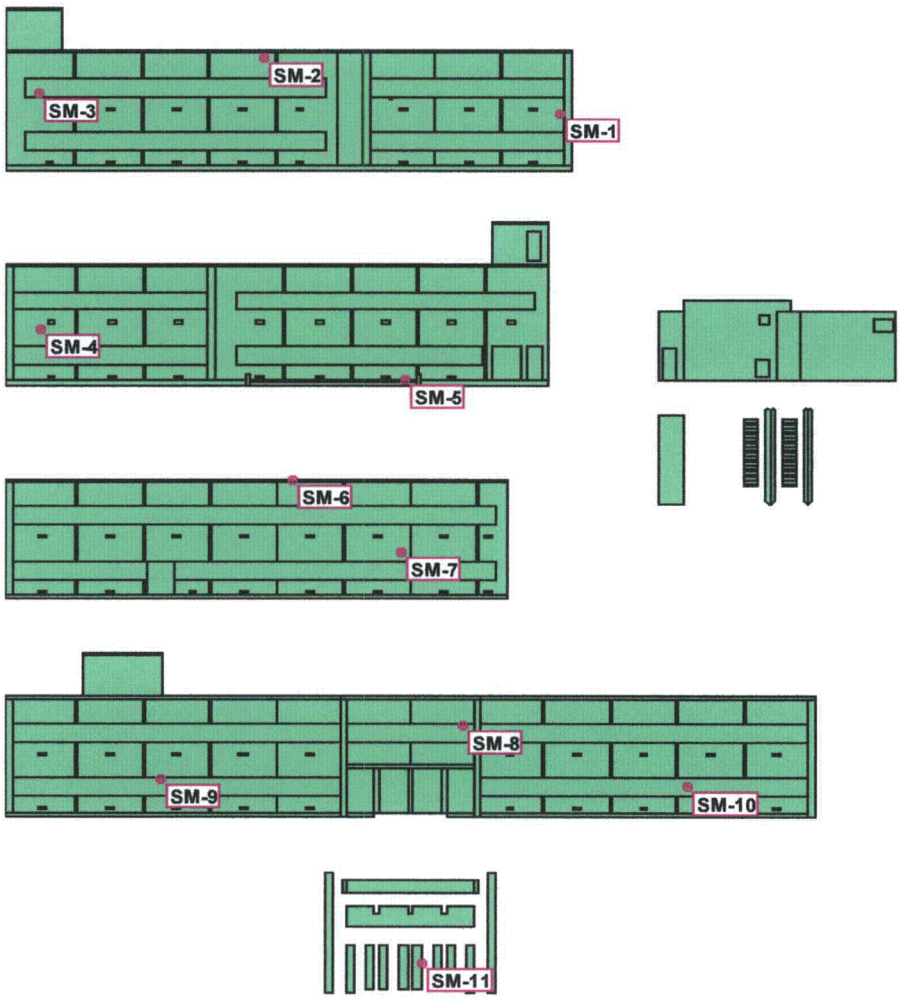
Survey Unit RO-4-1: ROLB Roof, Class 2					
X Coord (ft)	**Y Coord (ft)**	**Label**	**Value**	**Type**	**Notes**
5.9	5.6	SM-1	309	Systematic	N/A
0.4	15.2	SM-2	138	Systematic	N/A
11.4	15.2	SM-3	24	Systematic	N/A
5.9	24.7	SM-4	-163	Systematic	N/A
0.4	34.2	SM-5	146	Systematic	N/A
11.4	34.2	SM-6	813	Systematic	N/A
22.4	34.2	SM-7	577	Systematic	N/A
33.4	34.2	SM-8	358	Systematic	N/A
5.9	43.8	SM-9	919	Systematic	N/A
16.9	43.8	SM-10	1420	Systematic	N/A
27.9	43.8	SM-11	244	Systematic	N/A

Table Notes:

1. Measurement locations are established on a triangular grid with randomly selected starting coordinates.
2. Measurement values are in units of dpm/100-cm^2.
3. All of the sample measurements are taken from the southwest corner of the roof.

Survey Unit RO-4-2

ROLB Exterior Class 3 Survey Unit, Building Exterior walls



Survey Unit RO-4-2: ROLB Exterior Walls, Class 3					
X Coord (m)	**Y Coord (m)**	**Label**	**Value**	**Type**	**Notes**
- 0.2	1.2	SM-1	2510	Systematic	North Wall
- 0.6	- 0.3	SM-2	2440	Systematic	North Wall
0.8	0.2	SM-3	411	Systematic	North Wall
1.7	1.1	SM-4	1600	Systematic	South Wall
3.4	- 0.1	SM-5	1860	Systematic	South Wall
1.0	0.1	SM-6	192	Systematic	East Wall
- 0.5	0.6	SM-7	2330	Systematic	East Wall
- 0.8	- 0.1	SM-8	-62	Systematic	West Wall
1.0	- 0.05	SM-9	1930	Systematic	West Wall
0.6	0.7	SM-10	-48	Systematic	West Wall
- 0.05	1.7	SM-11	123	Systematic	Entrance

Table Notes:

1. Measurement locations are selected on a random basis – Class 3 survey unit.
2. Measurement values are in units of dpm/100-cm^2.
3. All of the fixed measurement coordinates are referenced to the lower left corner of the masonry section in which they are located.